This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

STANFORD·VNIVERSITY·LIBRARY

STANFORD·VNIVERSITY·LIBRARY

THE MONIST

A QUARTERLY MAGAZINE

DEVOTED TO THE PHILOSOPHY OF SCIENCE

VOLUME XXXI

STANFORD LIBRARY

CHICAGO
THE OPEN COURT PUBLISHING COMPANY
1921

BOOK REVIEWS AND NOTES.

Adamson, John William. A Short History of Education..... 318
Bosanquet, Bernard. What Religion Is..... 160
Brodetsky, S. A. First Course in Nomography..... 635
Burns, C. Delisle. International Politics..... 160
Cajori, Florian. A History of the Conception of Limits and Fluxions in Great Britain 319
Marett, R. R. Psychology and Folk-Lore..... 318
Piaggio, H. T. H. An Elementary Treatise on Differential Equations.... 637
Whitehead, A. N. The Organization of Thought, Education and Scientific 636

VOL. XXXI JANUARY, 1921 NO. 1

THE MONIST

HERBERT SPENCER'S WORK IN THE LIGHT OF HIS LIFE.

THE hundredth anniversary of Spencer's birth finds the world of science, as well as the world of affairs, quite different from what it was when the great philosopher first saw the light. In no respect, perhaps, has the change been greater than in the field of the social sciences. All of these, with the partial exception of economics and politics, have come into being in that hundred years. Spencer was himself one of the two greatest figures in the development of sociology; and it is primarily as a sociologist that he is remembered to-day. He probably did not think of himself as a sociologist so much as a philosopher, for his occasional indirect characterizations of himself use only that term after his period of writing begins. In his later years only did he become primarily engrossed in sociological theory. Even while working on his *Principles of Sociology* and directing the compilation of the *Descriptive Sociology,* and putting most of his income into it, he turned aside from these tasks to write the *Data of Ethics,* which he regarded as the embodiment of his chief ideas and the crown of his work, lest he should not live to accomplish his full plan.

What influences led Spencer to become interested in the subject of sociology it is difficult to say, for, in spite of his great pains in his autobiography to give the genesis and causes of his ideas, many things remain unaccounted for. Also, it is unfortunate that he wrote so largely from memory; the internal evidence of his autobiography shows so

conclusively and so repeatedly that his memory often played him false. That the idea of writing the *Sociology* grew naturally out of his classification of the sciences is patent enough, but from what his interest in sociology as such sprang he is able to give us little information. Undoubtedly in later years he developed a mental conflict about his indebtedness to Comte which inhibited his memory from recalling many suggestions which must have been given him by his great French predecessor and contemporary. He admitted having read Lewes's exposition of the Comtean system and most of Miss Martineau's translation of the *Philosophie positive,* and he says, "It is probable that but for my dissent from Comte's classification of the sciences, my attention would never have been drawn to the subject." He here refers to his own theory of the classification of the sciences.[1] Of his indebtedness to Comte he says, "The disciples of Comte think that I am much indebted to him; and so I am, but in a way widely unlike that which they mean....My pronounced opposition to his views led me to develop some of my own views."[2] The only suggestions which he acknowledges are the words "altruism" and "sociology."

Spencer began his literary career with the discussion of political problems, and he himself makes much of this as leading up to his later interest in social ethics. But this interest was largely a practical one at first and even in *Social Statics,* which appeared when he was [illegible] years of age, he was putting forth a [illegible] rather than a sociological treatise [illegible] writings. However, the ge[illegible] ethical bent are clearly [illegible] as he said, to di[illegible] definite as tho[illegible] only for the [illegible]

[1] *Autobio*[illegible]

in thought to expand and make more definite his growth in the direction of sociology. Among these influences Comte must certainly have played a large part. The truth seems to be that until he was almost forty years of age (in 1858) he had no settled plan of writing. His chief training had been in mathematics and the physical sciences; his chief activities were those of a civil engineer, an inventor, and later an editor and writer for reviews. Through the first half of his life his intellectual interests came largely by accident. He drifted into journalism while in search of a "filler," on the strength of some earlier contributions. His earlier review articles cover a variety of subjects, ranging from physics and astronomy to railway legislation and supervision. His first book, *Social Statics*, was more the result of a desire to put into permanent form the ideas contained in some early contributions to a controversial journal than the consequence of any systematic plan of authorship. Not long before the writing of this book he had been debating with himself and seeking the advice of friends as to whether he should devote his talents to art (he did some drawing and modeling), to engineering, or to literature; and as late as two years after he was on the point of migrating to New Zealand.[3]

There is no record that he ever made a definite decision, but rather he drifted into literature in the manner indi- d. His second book was also largely an accident. hing, not e defined in his account, led him to est hims olo ith the vigor of attack d persist er eristic of him, in spite of his his indolence, he as- sembl d put them into a book. P book was then conceived nich it was later fitted into. hirty-five) his literary career

had been fixed upon him, partly because of the development of his habits in this direction through several years of writing, and perhaps equally because of the injury to his health from too close application in finishing the *Psychology*. For a number of years still, however, he drifted in his interests, spending many months recuperating, writing review articles on various subjects, as they caught the fancy of his ever active and solitary mind, planning books, which he wrote only in part or in modified form, as, for instance, his *Education*. And finally, in 1858, just before Comte's death, he produced the outline of his synthetic philosophy, which obviously consists of some fragments of a vast encyclopedia modeled on the general outline of his classification of the sciences. The omissions from this series of projected works are as instructive as what he included. There is nothing on astronomy and geology, the reason being in part that he lacked sufficient familiarity with these subjects. But he also lacked a knowledge of biology and sociology and ethics. Perhaps the chief reason for the omissions was that these subjects did not promise to lend themselves so well to the speculative method of treatment. He was never at any time a grubber after facts. Even in his early days, so he tells us, he read little in technical fields and in his later life scarcely at all. He picked up his germinal ideas from various sources, most of which he forgot or never fully realized, perhaps as often from conversations as from books, and worked these out into organized systems on his long walks. The only book for which he collected facts by any orderly process, and that by proxy, was his *Principles of Sociology*; and there is good reason to suppose that many of his ideas on this subject were well formed before he collected the data for his generalizations. Indeed, the evidence seems to be that he knew little sociology, as the schoolmen know it, when he wrote his *Study of Sociology* in 1873. He was

at that time still engaged on his antecedent writings, in particular a revision of the *Principles of Psychology*. In some ways he seems to have enjoyed writing this little book on sociology most of all, and largely, it would seem from his accounts, because it led him into a new and entrancing field of speculation.

When he began his Synthetic Philosophy by writing *First Principles* his thinking was still dominated by physical concepts. This form, if not the substance, of his thinking, continued largely through the composition of the *Biology* and the revision of his *Psychology*. When he came to sociology he was inducted largely into a new world, that of human relationships. Previously he had not dealt with people, but with principles of biophysics and "cerebral physiology" which he pinned down upon the world of people to cover whatever of their nakedness of action they would cover. In this he was of course not unaffected by the conventional ideas of his time. In some ways he was most naively influenced by prevailing concepts and theories, although he did not realize this. His uncritical acceptance of the Utilitarian philosophy and psychology and of the prevailing laissez faire doctrines of social action are cases in point. His disagreement with these views, where such disagreement existed, was usually the result of his ignorance of the details of the theories rather than of any preconceptions to the contrary. His habit of not reading extensively left him delightfully free to work out his own applications or extensions of any theory which his remarkably versatile and receptive mind absorbed. Not being educated in the universities or in any formal sense, he lacked a foundation of accepted principles and academic prejudices—although he was not lacking in popular prejudices—which would inhibit him from giving his mind free play in any field. Thus he was peculiarly equipped to take any leading concept of the times and give to it a richness

This failure of Spencer to understand the real modern world created by the industrial revolution and made possible by the exploitation of the natural resources on a large scale is well illustrated by his imputed antithesis between militarism and industrialism. Such an antagonism was indeed normal to the early cultures of which he actually wrote and from which he drew his data. What Spencer failed to see is that militarism is never an end in itself in any age or social economy, except by perversion of its function, but that it is a means to exploitation which may serve one type of state as well as another, provided that state is bent upon exploitation rather than production. At the time of the transition to agriculture and the handicrafts, and even in the period of the domestic system, the development was predominantly one toward production and away from exploitation. The new types of industry were providing an abundance for an expanding population and therefore those engaged in them did not need to exploit their neighbors, but were rather the objects of exploitation by their neighbors who had not yet progressed so far in industrialization. Also, at that early period of industrialization there had not grown up a class division within the State which made it the business of one particular group—the capitalists—to exploit rather than to produce. There were, of course, class divisions in the earlier forms of the industrial societies, and some of these classes exploited others—instance slavery, which sometimes was the fruit of war and serfdom—but on the whole the earlier industrial societies were pretty largely units in productive enterprises, whether democratic units or otherwise, and since their raw materials were almost always to be found at home—except, in some cases, land, which must be acquired abroad for the support of an expanding population—they ordinarily had more to lose than to gain from war.

But the modern industrial State, which came fully into

existence with the industrial revolution, destroyed this nice internal balance and unity which had belonged to the earlier economic society. Instead of being based primarily upon an agricultural economy and fostering manufacture only as an adjunct to an agricultural economy, the industrial technique began to transcend the agricultural limitations, in the service of which it had developed, and made itself subsidiary to commerce, and later to finance. The factory system, in supplanting the handicrafts and domestic systems, produced only secondarily for home agricultural needs and primarily for world markets. It transformed human society from many relatively self-sufficing agricultural units, finding their greatest happiness in successfully defending themselves from the attacks of their less advanced and hungry competitors, into a complexity of peoples, many of whom remained for some time in the agricultural stage, but a few of whom adopted an aggressive industrial and commercial internationalism. This new internationalism, which so ruthlessly disturbed the peace and quiet of the agricultural groups and soon, by virtue of the superiority of its military technique and equipment, put the most primitive disturbers of the peace out of the running, was bent on a conquest of the world markets. This was made possible by the unprecedented exploitation of coal and iron, which substituted natural energy in unheard of quantities for human and animal muscle power, and built vast factories filled with machines which were the substitutes for men in production, and even vaster transportation systems to carry away these products. Soon the production of this leviathan exceeded the capacity of the people at home to purchase. And soon it ate up the available supplies of raw materials. The surplus of finished products was sent abroad for more raw materials to feed into its maw. This process was immediately profitable for the country which had fostered it. Population, always among the

limitations of the anthropological method. To the end of his career he remained unfriendly to the expansion of State functions, opposing in his seventy-third year State education when state education had become almost universal. In so far as his disapproval of State patronage was due to his non-conformist fear of state repression and partisan government propaganda there was much to be said, at least in the abstract, for his view. But his preference for private associations which might, if need be, defy the state was largely based upon certain misconceptions, in so far as it was not subconsciously motivated. In the first place, the industrialization of modern life has so multiplied its complexity that the individual or even the great majority of associations of individuals is no longer able to accomplish anything worthy of note apart from State aid. The curriculum is now too vast for individual school masters, such as his father and uncle, to cover it entire. The requirements for the sanitation of a modern city could not be met economically and efficiently by any association of less extent than that of all the citizens; nor would any other method of assessing charges for service or of compelling participation equal that of the laws of the State. Not only is society now much more complicated, but, by corollary, relationships are much more indirect. Imagine each man being his own meat inspection department or his own public health bureau to test the water supply, as well as undertaking to provide these conveniences for himself. The State may be aggressive, corrupt and often in the hands of special classes who use its prestige to exploit the weaker individuals, but it is the nearest approach to a balance of powers and to an impartial regulative system we now have or perhaps can have. As long as there is universal suffrage there is a chance that the people may capture the State from the hands of exploiting classes, if only they are sufficiently intelligent. At any rate such

capture is easier of accomplishment than for the weak individuals, unaided by the State, to pit their puny understanding and resources, through the medium of voluntary organization—as Spencer urged—against the expert organization wielded by the choicest intellects and financed by unlimited means of the selfish powers that prey upon the masses, at home and abroad. This is a lesson which labor is slowly learning in our day, as it turns from the relatively direct organization of labor union to political action through a political party in its attempt adequately to influence the State through the capture of the government.

Spencer's failure to perceive the trend of the times in respect to the growth of the powers of the State, especially in the direction of beneficent organization and functions, was not alone due to his non-conformist prejudice and country localism, although these probably played the larger part. His intellectual stubbornness, growing in part, perhaps, out of his shyness and strong self-feeling and his training from early years in argumentation, and above all from the isolation in which he received his education, his few fellow pupils being uniformly of inferior caliber to himself, predisposed him to discount other people's opinions. Once he accepted an idea he held on to it tenaciously lest a change of view should indicate defeat and imply a confession of intellectual inferiority which he could not endure. All this is well illustrated in his strongly critical spirit as an engineer, where he did not hesitate to comment adversely on the ideas of his superiors, and in his slight recognition of what he owed to other thinkers, including Comte. So little was he able to argue dispassionately that, as he remarks, the subject of the positivist philosophy was taboo in the conversations between him and the Leweses, that being the only topic regarding which there was fundamental disagreement between them. Again and again he

it which he knew was to weaken the powers of the State and increase those of private associations. He could not foresee the full fruition of the powers of capitalism as an example of private associations. Regarding the equality of the sexes, social as well as individual, he seems also to have changed his views; and he no longer allowed for the same unconventionality of sexual unions which his earlier views had tolerated.

The causes of these changes in attitude are obscure. There is a singular reticence and lack of detail in his autobiography about some aspects of his life. In attempting to trace out for the reader the development of his main theories, he often concentrates unduly on formal facts, such as the first appearance of an idea in his correspondence, or the first mention of a plan or prospectus in his writings. He himself apparently had forgotten, if indeed he ever recognized, the concrete and intimate situations out of which his ideas and orientations grew. He does say, however, of his growing political conservatism, that in his youth he thought only some formal political or legal changes were necessary to bring in a new social era, but that he gradually came to realize that the process of fundamental change was much more complex than that. He perceived that changes must take place in the natures of men before they could become effective and lasting in their institutions. This sort of change, in spite of his optimistic belief in the inheritability of acquired characteristics, he regarded as extremely slow, so slow as almost to discourage one in the hope of any change at all. It is interesting to speculate as to what hope of reform he would have had if he had accepted the theories of Weismann on heredity.

Undoubtedly much of this conservative trend was temperamental and personal. Although he speaks infrequently of the stupidity of the public in connection with the reception accorded by it to his books and articles, those remarks

are sufficiently pointed to show the ill-repressed rancor that lay beneath. At one point he contemptuously compares the success of Foerster's *Life of Dickens* in selling 10,000 copies in three months to the non-success of one of his own books which, by implication, is of much more importance to mankind. Of his earlier works, which received little or no intelligent notice from the reviewers, he wrote what he considered model reviews and inserted them in his autobiography. There is no question of contemporaries that he was a deductivist merely. His chronic ill health and depression resulting from dyspepsia doubtless also had a marked effect on his outlook upon life. He early became detached from the masses of his fellow beings and felt that detachment strongly. Little things, which are usually neglected in history and biography, probably played their part. A number of times he was irritated at the, as he thought, unwise compulsions of the State. Once his father suffered considerable loss from some supposedly unintelligent sanitary requirements imposed upon houses he owned, and he himself was similarly annoyed when he inherited the property. References to this are repeated and disclose strong irritation. To a man more or less psychopathic and neurotic—Spencer undoubtedly suffered greatly from neurasthenia, as well as insomnia—such apparently small incidents might easily create a psychic complex which would dominate much of his thinking in after life. Nor should there be left out of account the fact of his almost exclusive intellectual association in his later years with men of property and conservative university professors and clubmen, including retired army and naval officers and civil service men. Always impressionable to a high degree, in spite of his strong subconscious reaction against the signs of external influence—which he usually recognized only when put in the form of argument—he could not have escaped this source of the molding of his opinions.

His changed views on the function of religion in society perhaps illustrate as well as anything his increasing disappointment in the popular intelligence. In his early days he seems, in common with most thoughtful young people, to have regarded life as pretty much a matter of logic. He saw social problems as problems of abstract truth. His concern with religion to almost the end of his life was primarily as to its reasonableness. His own evolution in religious concepts required almost sixty years for its completion, arriving finally at a completely agnostic position. But finally he came to see that religion had arisen, even in its cruder forms, largely out of the needs of man for effective social control. His early libertarian views in regard to the ability of the masses to control themselves and their society through the unaided and immediate exercise of human reason gave way in the face of accumulated facts. In the light of his study of human society he came "to the conclusion that the control exercised over men's conduct by theological beliefs and priestly agency, has been indispensable....So conspicuous are the proofs that among unallied races in different parts of the globe, progress in civilization has gone along with development of a religious system, absolute in its dogmas and terrible in its threatened penalties, administered by a powerful priesthood, that there seems to be no escape from the inference that the maintenance of social subordination has peremptorily required the aid of some such agency."[9] It would have been only a step further in his thinking to have recognized that similar limitations upon the powers of human reason and initiative, particularly in a very complex industrial world, would make necessary the continued growth in powers of a beneficent State. He might even have reasoned that as mankind come increasingly to substitute the technique of science for that of magic in their thinking and in their

[9] *Ibid.*, II, 845.

control over the external world, they may as safely turn more and more from the dogmatism of traditional religion to the dogmatism and conventions of the State, which may in time become increasingly rationalized in response to the growth of an intelligent democracy. But his prejudices were too deeply set for his intellect to make this leap in his old age. He was headed in the direction of reaction—back toward dogmatic religion, as a regrettable concession to facts as he saw them, and not forward to a growing and rationalized, democratically controlled State. Although he observed twice in his autobiography that it is the workers who oppose modern wars, the evils of which he sees clearly enough, and the upper classes who foster them, he does not learn a lesson in democracy—that the cure for democracy is more and less obstructed democracy—from these facts. If he still lived, in the hundredth year after his birth, he would have before him the interesting spectacle of the laborers of his own country, almost single-handed, placing a veto upon war in order that they might save the remnants of a sadly shattered civilization. It is the workers and not their rulers who appear to have the vision to protect the future of the human race. But, perhaps, Spencer would say—however contradictory that might be to his main argument of the incapacity of the masses for democratic control—that we have here the voluntary organization of the workers against the State. So it is, but a voluntary organization which may soon capture the control of the State through the ballot and thus become the government.

Spencer's long period of semi-invalidism, lasting from the publication of his second book at the age of thirty-five until his death nearly fifty years later, and becoming gradually worse during that time, has usually been regarded as a distinct disadvantage to him. In many ways it was. His output, great as it was in spite of these difficulties, was doubtless cut down considerably. In his later working

years he was frequently able to dictate only fifteen lines a day, and often none at all. For several years five ten-minute periods was a maximum day's work. Whole months and years were lost at various intervals of his career, and even at the best, after his breakdown in 1855, he was able to write only three hours a day. This limitation upon his time, added to his earlier dislike for consecutive task reading, prevented him from having at his disposal a mass of concrete data and of statistical materials which would have done much to correct the *a priori* character of his thinking. In the later works on social subjects this deficiency was in some measure met by the large collection of data which his assistants gathered for him and which constituted the subject matter of the *Descriptive Sociology*. But all of this material was second hand to him in a double sense. It represented, in the first instance, the impressions of other men who often had preconceptions which warped their observational powers. Also it was selected by other men from the original sources for his own personal use and could not therefore represent his own critical choice. However, his lessened ability to compose was not altogether a handicap to him, his method of writing being what it was. In fact this inability largely determined his method of production. At least in the middle years of his career it did not greatly limit his time for thinking. If anything, it increased the proportion of the time given to reflection to that devoted to composition, which was probably a very good thing. It resulted in his books being most carefully thought out and organized with a thoroughness and precision which have characterized the works of but few authors. He brought to each period of composition well digested material which expressed itself with an admirable lucidity, rendering his books the most fascinating reading of modern philosophers. Closing to him in large measure the avenue to concrete induction because of lack

of materials, it drove him more and more into ultimate generalizations. Necessarily many of these have not stood the test of time, but it was a very valuable thing to have done. Probably no one else in the nineteenth century did so much to open up new lines of thought and to stimulate constructive and critical thinking.

This generalizing habit had been characteristic of him from childhood, and he believed that it was inherited from his father. A more likely source is that of the type of education which he received from his father, who early trained him in intellectual self-reliance and especially in looking for causes of things. He was never subjected to a formal schooling process, which would have served to fill him with predigested knowledge rather than stimulate him to discover truths for himself. Moreover, he was never hurried, either in his education in books or in his adjustments in life. For nearly half of his life he did not know what he would do next. Even at long past the age of forty he was seeking from John Stuart Mill and others some political sinecure—seeking aid of the State when he would not take it from friends, contradictory as this may seem in the light of his political theories—to enable him to carry on his work. Often he remarks upon his lack of ability to make a practical success in life. All his life, but more particularly in his formative years, he was left free to work out his intellectual adjustment to the world. This undoubtedly stimulated him to do independent thinking and to make those long associations between facts, which we call generalizing on a wide scale.

But free as he was in his intellectual development, he was by no means neglected in this respect. Few if any men have had fathers more keenly alert to the training of their sons or more intelligent in carrying out that training. At the age of thirteen he was put under the tutorship of his uncle Thomas, apparently that he might gain new view-

points and have new companions in his studies. From the beginning his environment had been serious and intellectual, although not forced. Now began a correspondence between him and his father which continued at very frequent intervals for thirty-three years, until his father's death. One cannot but be struck by the mass of this correspondence, two or three letters not infrequently being dated in the same week. After leaving his uncle's house he also kept up a similar correspondence in this quarter. And later there was a considerable interchange of letters with friends, until his health made this largely impossible. But the subject matter of this correspondence is the remarkable thing. It is doubtful if there are many such correspondences in this day, even between professors and their sons. It seems to have been deliberately planned by the elder Spencer to produce certain desired results in carrying out his theories of education. From the beginning the prevailing items of interest are intellectual rather than gossip. There are literally hundreds of problems in mathematics put by father to son and solved by the latter. This seems always to have been interesting to the younger Spencer. By and by the son puts problems to the father, or sends him original demonstrations and theorems of his own. Later they discuss politics. When the son is working as a civil engineer there are endless discussions about projected inventions, physical and astronomical theories, and experiments in chemistry. Later in life this interest expands into the realms of philosophy and metaphysics. The father keeps the intellectual respect of his son to the end, showing an ability to follow him in all his thinking. He is keenly interested in every undertaking. Even when past seventy he served for a time as the son's amanuensis. The father largely devoted his life to the education and encouragement of his son. There are few instances like it in history.

Spencer's education was always highly unconventional. He never wasted his time on the classics, although this was the chief element in English education when he was growing up. His father and uncle had directed his attention from the start to an understanding of the living world. Besides his major interest in mathematics, he was also deeply concerned with biology and made extensive collections of plant and animal specimens through the first half of his life. He also studied geology in the field and for some years did chemical experiments in private laboratories which he and his companions rigged up for themselves. Through his uncle in particular, he very early became interested in political movements, making contributions to the press in this field while still in his 'teens. He had little respect for the merely traditional in education, just as in life. His remarks on this subject in his autobiography are most informing and interesting.[10] Much of his training also came from his friends, especially after he went up to London to engage definitely in a literary career, beginning in his thirties. Lewes seems to have been the first from whom he gained inspiration and guidance. He and Lewes took walking trips, lasting for days at a time, which were filled with discussion and speculation. Both got suggestions for articles out of these conversations. Lewes was the better read of the two and knew the history of human thought. Spencer's was perhaps the more powerful mind. After Lewes came Huxley who undoubtedly for some years served Spencer as a sort of work of reference on concrete facts and processes, particularly in the field of biology. He was for some time accustomed to go to Huxley's laboratory at the hour in the afternoon at which the latter left for home and walk with him and discuss the problems he had been thinking over through the day. When he wrote his *Principles of Biology* Huxley, Hooker and some other

[10] *Ibid.*, II, 43, 307-10.

friends checked him up on matters of detail to make more authentic his generalizations. Already he was greatly handicapped in his power to read and had to depend largely on conversation and discussion for verification of his ideas.

His method of thinking was among the most characteristic things about him.[11] He thought in the same leisurely way in which he grew up intellectually. An idea once lodged in his mind was left largely to take care of itself while the owner of the mind went about the intellectual business in hand. The result was that a great deal of subconscious thinking, if one may use such a phrase, was done. So active was his brain that the complex of stimuli, which represented ideas coming from without, spontaneously set up widely functioning and connecting neural processes throughout the association centers of his brain, with the result that all of his mental content was soon brought to bear upon the proposition with little or no effort. The idea complex remained there in the mind serving to collect and assimilate all new ideas and percepts which came within its field. Now and then it would rise into consciousness, reinforced by previous subconscious accumulations, and these would be sorted out and classified and then laid aside to accumulate and assimilate again. Thus his thinking was remarkably spontaneous, being almost wholly free from that drudgery and effort which characterize the novice and the relatively inefficient in thought. In the light of these facts it would seem that Rodin's statue of the thinker represents rather one who is emotionally disturbed and perplexed than one to the manner of thought born. Spencer used his walks and his conversations for the spontaneous recall of his ideas and their classification and comparison, which we call thought, much as some teachers use their class lecture periods for the same purpose, or as Kant apparently employed the neighboring

[11] *Ibid.*, I, 463ff.

church steeple, as he sat at his window in the twilight. In his youth Spencer was greatly given to day dreaming. His later intellectual life partook largely of the same character, in so far as its subconscious spontaneity was concerned.

His method of working was adapted to and grew out of the limitations upon his working time.[12] He used something very much like a card index system, only mechanically more convenient, classifying and arranging his data around him within easy reach of where he sat. As he dictated to his amanuensis the results of his previous thought he took the particular illustrative material which was pertinent to the subject in hand and passed it to his secretary to be labeled and included in the text. Most of his books were dictated, because of the necessity of relieving himself of the strain of writing. The effect of this, he thought, was to render his style somewhat more declamatory and less condensed. It probably also made it clearer, because his ideas had largely formed in verbal imagery before he began to dictate. In later years, when he could afford the expense, he kept a separate room at some distance from his lodgings, where his materials were and where he spent as much of the morning as he was able with his amanuensis at work. At times when he could work only a few minutes at a time and while his bodily strength remained intact—as it did until after the age of sixty—he frequently took his amanuensis on the water and spent sometime rowing for relaxation between brief periods of dictation. At other times he engaged in some game of manual skill or in walking to break periods of dictation or revision of manuscripts and proof. Even on his trips and when a guest he endeavored to do a little work each day, often stopping for a few minutes by the wayside to write or revise. His persistence at work, in spite of his handicaps, was most re-

[12] *Ibid.*, II, 324ff.

or reveals his plans. In a way Youmans overshadows Huxley and Hooker and Tyndall and the others in these later years, but they are not forgotten. He meets them at the club and he honors the meetings of the British Association with his presence when one of them is president. They are very dear to him. But in his illness he leans on Youmans, or on his non-scientific boyhood friend Lott, who goes with him on the trip to America and never leaves his side.

But fond as he was of his friends he was capable of marked aversions. He never liked Comte, although he once discharged a commission to him at Paris for some friends. How much this dislike was due to Comte's theories, which he regarded as in most respects quite contrary to his own, and how much to the fact that he was considered by most English Comteans to be largely indebted to the great positivist, it is difficult to say. That his sub-consciousness was largely back of this dislike seems more than merely likely. If he had an aversion to Comte, he positively detested Carlyle. Lewes introduced him to the famous Scotch philosopher in London, but he went only a few times to see him. His tirade against him[14] is one of the curiosities of literature. He could not endure his egotism, his intellectual dishonesty, his ceaseless belligerency, his shallowness, as he expressed it. Amid all this invective he lets the secret out. He found it impossible to argue with Carlyle, and he was used to dominating arguments himself.

For a man who accomplished so much he spent an enormous amount of time in recreation. Most of the summer months was spent with friends in Scotland or Wales, or the English country side, with occasional visits to Paris, Switzerland, Holland, Italy, Egypt and even, on one occasion, the United States. He did not go much to Derby

[14] *Ibid.*, I, 440ff.

after his parents died, but this place he also made once or twice a year or oftener until almost his fiftieth year. In addition to the more pretentious trips he often went away for a day or a week or two at all seasons of the year except mid-winter, in search of diversion and rest, always seeking sleep. At all times he spent most of his afternoons either in walking or at the club. Fishing was, after walking, his great solitary sport; but he could not bear to be alone. Without a companion he fretted, went restlessly and ceaselessly from place to place, growing nervous and sleeping less. He needed contact with people, even when he could not bear the strain of much conversation. He seemed to like best to visit at houses where there were young people, especially children.

That Spencer never married was a matter of mixed regret and self-congratulation with him. If he ever felt the gentle flame with any degree of warmth he does not confess it. There was a sort of attachment in his early student days, in his early teens; and later, when he was a young engineer, a young lady more sophisticated than he made possible the kindling of the torch; but nothing came of it. He records with some interest and a denial of its justification that many people, seeing him and Miss Evans frequently together, when he was working on the *Economist* in his early thirties and had complimentary tickets to the opera, thought there was something more than philosophic interest between them. On another occasion a friend presented to him, with the avowed purpose of matchmaking, a young lady intellectually fit but physically unprepossessing; and he assures his reader more than once that physical attractiveness was also necessary for him in such a union. He not infrequently regretted his loneliness and was inclined to attribute his depression in no small degree to it. But he realized that his choice was between marriage and his work. His reflections on this point are

joying the scenery of the mountains, of which he was extremely fond, or fishing, at which—after some years of abstinence, for ethical reasons—he became quite proficient. His rambles with friends all too frequently served for further discussion, although they doubtless also gave him relaxation. While on his country expeditions he worked out theories of geological displacement or invented new devices for fishing. Among these latter inventions was an improved folding rod and a mechanical fly, intended to prove that the fish used little discrimination in distinguishing the nature of their intended food; which led George Eliot to remark to him that he even fished with a generalization. Unquestionably this great activity of mind was constantly urging him on to generalizations and conclusions far in advance of any complete data in hand, much as the daring tactician goes far in front of his supply train to make a bold attack and bring up his provisions afterward. If it could be said of Laplace that in his thinking about celestial mechanics he often leaped whole series of equations, going on to more ultimate results in the series which his wonderful mathematical mind saw as if by inference, leaving the less able who puzzled along after him to supply the missing equations, it can with equal truth be said of Spencer that he sensed the generalized meaning and implications of apparently isolated facts in unusual degree and that he made systems out of them for which most of his contemporaries were not yet prepared. If the concrete data more often refused to support his conclusions than was the case with Laplace, this must in part be attributed to the fact that Spencer's field of thought was relatively more complex and the explorations in it much less numerous and less plainly marked. That his was the type of mind of which the greatest thinkers are made cannot be doubted. The painstaking worker in the laboratory who grafts tissues, or weighs ions, or photographs light waves, or com-

putes population curves, is indispensable; but after all he is only preparing data to be used by the man who can think these facts into an explanation of things. When there appears a man who can do both—it is doubtful if Spencer would have had the patience, if he had possessed the health, to do the detailed work—he has the advantage of a greater and closer familiarity with his tools for generalization, as well as the facility for manufacturing some of them himself, thus effecting a certain economy in procedure. But it may be questioned whether more is not often lost than gained by this absorption of the generalizer in manual details. Of course, the decision here turns largely on the scope of the generalization to be made. In a field so vast as Spencer's much of his time would have been wasted if he had attempted to do this detailed work for himself.[17]

This great activity of thought, leading him far in advance of his effective support, as it were, often betrayed him into serious error. Many of his published theories have been called in question or disproved in recent years. The criticisms in this article have been based rather on another fault: his failure to understand his times, the stage in social evolution which he himself had reached or was on the point of entering. An error of generalization without sufficient supporting data may also be mentioned, that of his theory of bicerebral thought. He explained double consciousness and dreams within dreams as the result of the independent thought action of the two hemispheres of the brain.[18] He apparently did not have the concept of neural complexes, acting more or less independently of one another, which is quite adequate to explain the phenomena of subconsciousness and multiple personality, and is much more plausible. He also persisted to the end in his belief

[17] For an attempted justification of the type of generalization (as distinguished from content) performed by Spencer see "The Function of Generalization," *The Monist*, October, 1920.

[18] *Autobiography*, I, 459.

in the inheritance of acquired characters, devoting several pages in his autobiography[19] to evidence drawn from his own case, using the simple and discredited method of treating mere coincidences or similarities between parent and child as conclusive evidence of inheritance. Such data offer just as good argument in favor of the acquirement of characters by imitation, subconscious or otherwise. But it must be admitted that Spencer is not alone in this fallacious method of reasoning. The ultrabiological eugenists still largely make use of it.

Spencer also had a very strong self-complex, if the indirect evidence of his autobiography can be trusted. The references to his physical condition are exceedingly numerous, and one sometimes wonders if that condition was not rendered worse by autosuggestion. There was no organic trouble, just nervous fatigue and consequent indigestion and depression. When he could get away from himself and his depression, among friends or new scenes, he approached more nearly to the normal. Children gave him something of this diversion, especially in later years, and relieved him accordingly. Although originally considerably of a Puritan in his attitudes, as one brought up in a non-conformist family might be expected to be, his chronic disability led him in later years to be more indulgent with himself. His philosophical hedonism, which he had copied from the Utilitarians, doubtless contributed largely to this, winning out over his early Puritanism, as his theological environment was gradually dissipated. His fondness for club life was marked. He was much more willing to give his time to club politics, even when his strength could ill afford it, than to public movements, which ordinarily he avoided. His fondness for billiards was due in part to his need for non-intellectual diversion, but on one occasion it caused a faithful admirer and pilgrim to his shrine to turn

[19] *Ibid.*, II, 511-515.

away in disappointment and astonishment. At one time in writing to Youmans he says, "Marvelous to relate, I am now able to drink beer with impunity and I think with benefit—a thing I have not been able to do for these fifteen years or more." Yet with all his play he was haunted by a strong sense of responsibility for the proper use of his time. Even in his more competent years he refused to stand either for Parliament or for the rectorship of St. Andrews, on the ground that he could do more with his limited working time for social progress through his writing than in such practical service. He resented very strongly the non-inclusion of his books in the library of the University of London, and was much pleased by the attention he early received from students and faculty at Oxford and Cambridge.

It is to be expected that much of the giant superstructure of Spencer's synthetic philosophy will in the course of time have to be torn down or remodeled. Such a fate must ultimately happen to the product of all thinkers in a constantly changing world. To the boldest adventurers it may come more quickly than to others, but their honor is in no small degree in having blazed the trails. Spencer was peculiarly fitted by constitution and by training—rather the lack of any formal training, with its implied allegiances to the schools—for this work of intellectual adventuring, in the best sense of the word. It is not fewer Spencers that we need, but always more, with the courage of their convictions and the first-rate ability which was his to bring together in new and in more obvious relationships facts which before had seemed widely separated or even antagonistic. This is true intellectual pioneering; the function of the great generalizer, of the true philosopher.

L. L. BERNARD.

UNIVERSITY OF MINNESOTA.

nected, with occasional bursts of what we call a train of thought. It will probably continue to be difficult to visualize the process until some one has invented some way of recording accurately the series of obsessions and reproducing them slowly. The thread a spider uses is only apparently a thread: so our thought is only apparently connected: given the means of magnifying sufficiently, we should probably be led to think of our mental universe as a body touched to sensitiveness in various parts—sensations flashing out here, there and everywhere in twinges. For it is probably much more than a simile to call a thought an ache.

The nearest we get to this desirable experiment is a baby thinking. It gazes—"yes," it thinks, "that is something: it's different from everything else." It then gazes at something else: and then looks back at number one. The difference here is fundamental: when it has only one pattern, it knows only "that" and the "not-that": but, having passed to the other pattern, it can ignore the very unsatisfactory "not-that" and play with two thats.

It would also be interesting to see, if thought could be slowed down for experimental purposes, whether we judge things, not, as is commonly supposed, entirely by what they are, but largely by what they are not. Thus if I see a car on a road, I do not really know where it is until I know (or have at least a sufficient idea of) where it is not. This is what one would expect, if a pattern is scaled: for a scale is useless unless we use it *as a whole*. The scale may be elastic, it may be vague; but we cannot know the intention of a scale unless we get its extension.

A few examples will serve to make this clear.

Timbuctoo: using the space scale we have it *there*: the scale is space, the world, the universe—as vaguely as may be, but none the less the whole space scale implied. Other scales such as time,—Timbuctoo when? now? or at some

other time?—or size (etc.) may also be implied. But it is clear that my knowledge of the position of Timbuctoo depends entirely on my knowing at least something about where it isn't.

Der Tag: This is a notorious pattern. But it is not hard to see that it is quite meaningless, unless we know about the days that were not "Der Tag." We cannot here go into an analysis of this phrase: but it would be a fascinating pursuit.

A bee: is it a peculiarity of my own mind that makes me suggest that in arriving at our idea of a bee we knock out certain things that it isn't? We see an instance of bee, I grant, without shuffling in this way; we either do or do not know what *bee* or the visible insect itself *stands for*. But what they stand for is not a mere proper name or label: in so far as it has meaning, we are bound to run along scales, fixing in our mind where *bee* comes by determining (as accurately as need be) where it isn't.

A Grain of Salt: a chemist clearly has a more or less clear idea of what it isn't. But if we consider the phrase as used in the sentence "to take a statement with a grain of salt," we have (have we not?) the same process. To take with a grain of salt is *not* disbelief, is *not* belief. The Japanese describe an argument about the size of a thing as *Okii chiisai no arassi*—dispute of big? small? The phrase graphically describes the movement of the mind over a scale, until it comes to an intermediate position by excluding extremes.

Crimson: the simplicity and the complexity of such a pattern are evident: there is no meaning at all in the word —it is a mere label—unless we have some conception of the non-crimson; just as light-red can have meaning only as on a scale of all-the-reds. The more we know of what crimson isn't, the more accurately we know where crimson *comes on our scale*: what crimson is, is quite another matter.

Outrageous: this is a good example of definition by the negative. The word is equivalent to such a hypothetical word as "beyondageous": conduct is outrageous when it is *outre* or beyond every scale of conduct: such conduct is declared to find no place on the scale of conduct considered ethically: it is not good—it is not even bad—it is not even the worst conceivable—it is beyond anything that can be called conduct. It is a neat conception, similar to the very expressive Japanese *nai koto wa nai*, (isn't isn't, meaning "there is some").

Shrill as applied to sounds. We are apt to say that such qualities as shrillness are relative: so they are: if we are accustomed to a supershrill voice, we shall consider a rather shrill voice, perhaps, as not shrill at all. But if we knew no voices or noises that were not shrill, what meaning could we attach to shrill?

Elastic: that is a fascinating pattern: a child is quite at home with it, "knowing" all about what is not elastic: but as we come to consider what is not elastic, our conception of elasticity becomes more and more shaky: we must in order to understand elasticity understand non-elasticity —a task that becomes more and more difficult. For most of us elasticity will be understood only relatively in a small field of conditions. To avoid ambiguities, there ought to be as many words for "elasticity" as there are conceptions of the "non-elasticity" which scales it.

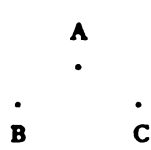
Death: this too is a pattern, the background or negative of which is now so vague that men can argue that there is nothing "alive" or that there is nothing "dead." But for practical purposes, the scale is got negatively: it is inconceivable apart from time and space scales: it is the absence of something (life) that has been somewhere: it is not mere darkness—it is darkness where light has been: just as when a child plays on the shore and makes sand pies with a pail—and the sand pie has the form of where

the pail wasn't,—so death is formed by the conception "life"—it is the pattern left by the removal of life. We cannot here go into this analysis more fully. But we have perhaps shown that here too our pattern (death) is meaningless unless we have hold of the pattern non-death which it implies and requires.

Matter: here we have a pattern of which the scale (or non-matter) has gradually been evaporated, so that it is possible to say that as (if) we can have no conception of what is non-matter, so we can have no conception of matter.

We have then in answer to the question "That is what?" a pattern which is (or may be) scaled. "That" is always like a silhouette which has no "meaning" except in so far as it stands out against a background. The wonderful rapidity with which we supply a series of backgrounds to our complicated conceptions gives them the appearance of body, life and movement—an illusion we may see on a very limited scale in any cinema. To some extent the process may be visualized (very incompletely and inadequately) as follows:

Take three points A, B and C, thus:



Time Scale: anywhere in the past (we imply that it is at some moment that could be but need not be stated).

Space Scale: somewhere in London (we could state the spot more accurately if necessary).

The spot A is a king one. Your mind is now active supplying a number of scales, by means of which your silhouette is gradually made to stand out until you can see a king. There can be no doubt

whatever that your silhouette and mine would be seen to differ if they could be recorded.

The spot B is a horse one—a white horse one—an Arab white horse one. Here again, you will admit, your mind has been hard at work: it has conceived and brought forth what you imagine I mean.

The spot C is a prince one. The same process produces a third silhouette.

All this is only preliminary to the real work: for these points are only circumstances or epithets qualifying what we are talking about—namely that there was then and there a giving which was a King—Prince—Horse giving, the direction being from the King to the Prince. Put in a formal way we are stating that One gave One One, A gave B to C, there was a B giving from A to C or an ABC giving then there. In this simple sentence "The King gave the prince a horse" we see that we have as our pattern a "giving" and that we give it meaning by an incredibly rapid use of a number of scales, by means of which we block in (as it were) a background until our pattern stands out like a snow peak against a cloudy background. Thus we get back to the iceberg we spoke of before: we deal with the visible portion—ignoring the infinite remainder, but using (as it were) the sea and the sky (these also having infinite remainders) as finite scales by means of which we outline that part of the iceberg which concerns us. It sounds complicated: but thought is complicated.

We must now deal with the difference between the questions "That is what?" and "That is who?" There is a subtle difference here: the failure to notice it (and it is a common failure) explains a host of mistakes in the past. The question "That is who?" posits individuality: and an individual is a pattern without a background or meaning.

As we saw before, an individual horse is usually called by anything but "horse." Any name does to mark an individual: in that an individual is unique, an individual is a class consisting of one member, and classification can go no further. Of course it is possible to consider a person not as a person but as a thing: instead of asking "Who is that?" it is possible to ask "What is that?" In early times there was a tendency to ask about mountains, trees, rivers, the sky, the earth and the stars "Who is that?" There is, throughout history a gradual reduction of the use of the question "Who is that?" Some of us may even have got so far as to ask "What is this?" for "What am I?" But it seems probable that until human passions and emotions are reduced to a state of impotence which many desire but few approach, we shall have to continue using the question "Who is that?" which implies individuality, a person, a soul or whatever it is we introduce into our thinking when we use a pattern without a scale. And until, as we said, the world changes so radically as to give up this interesting habit, taking to looking upon experience as full of what we have called scaled patterns, until that happens we shall continue to have three main divisions of philosophy: firstly, pure philosophy which is the proof that we can know nothing—given both in India and Greece long before the time of Christ; and then, applied philosophy which answers the two questions "That is what?" (and under this heading comes all science) and "That is who?" (and under this heading comes all ethical and religious speculation). We have no difficulty in admitting that, however complicated may be the process, we can get an answer to our question "That is what?"—a satisfactory answer, useful and fruitful—what we call SENSE. It may seem absurd, at first sight, to say that the answer to the question "That is who?" can never be sense: but not if we distinguish, as we shall have to, between nonsense (which has no meaning,

but has import) and bosh (which has neither meaning nor import). Our nurseries are full of the nonsense of religion: *"boys don't cry"* has no connection with the sense that has built up science; nor if small boys were looked upon as things would the phrase ever be used; but given the attitude implied in "my darling boy," what more natural, useful and important than such nonsense? Nonsense (not bosh) is the salt of thinking: the next chapter will deal with it more fully.

VII.

We have seen that to the question "What is that?" there can be no answer. To the question "That is what?" we answer in the form "That is that." Further than that we cannot go: the whole of science has been built up on that equation. But the students of pure philosophy who convince themselves that there can be no answer to the question "What is that?" and the students of science who are content to use only equations are still a minority in the world. What Professor Rhys Davids calls the "soul theory" is still prevalent; in olden days there was "an almost universal and unquestioned belief in the existence, round and about, of an infinite number of non-human beings. These the people took as a matter of course, just as they took the existence of souls inside their own bodies as a matter of course. It was by these souls, within them and without, that they explained to themselves the mysteries of death and trance, and dreams, of motion and of life." We still do. Our science is still shot through and through with traces of it. "Atoms" and the so-called "Laws of Nature" are often nothing but up-to-date "souls." Gautama seems to have tried to kill the soul theory: with what success we know. It is possible that man cannot thrive on nescience and equations: ages of superstition may have so tempered the human mind that it starves with-

out it: and perhaps if one tried to live without the soul theory he would go mad. This point (and many others) is fully dealt with in Burton's Anatomy of Melancholy. "*Dulce est desipere in loco*; to play the fool now and then, is not amiss; there is a time for all things." If pure philosophy teaches nescience, and applied philosophy the use of equations, it would seem that in order to keep the *mens hilaris*, the philosophers must be able to unbend and indulge in nonsense. And, though it is rightly to be called non-sense, being illogical or alogical, it will be best to use a less damaging name. Call the result of pure philosophy nescience and the results of applied philosophy either truth (which is merely the statement of an equation) or common sense (which differs from truth in that it postulates the theory of souls). Put more accurately: we have three main divisions of philosophy: (A) That part which deals with how and what we know: the answer being that we know by symbols, and that we know nothing, except (B) the equivalence of symbols, which is our science, the whole built up by elaborating the implications of equations; and (C) common sense which may be called an art built up in flagrant defiance of the first result of philosophy, namely nescience. Many philosophers have admitted the importance of the highly illogical products of common sense; others have despised them, as mathematicians may despise those who "waste their time" trying to square the circle. But what if it is natural to human beings (as natural as eating and breathing) to "try the impossible"? It seems not unreasonable to say that happiness is often found—perhaps always found—in those who are pursuing something that is obviously (even to themselves) out of reach. If that is so, our professors of philosophies will have in future to teach not only nescience, not only science, but also common sense.

If common sense is ever to become a part of philosophic

teaching (and we think it ought to) it is important to see exactly what it is and how it works. We have already seen that it is not the sense of science, which is always an equation on the model of "That is that." We have also seen that it seems to deal with patterns that cannot be scaled: for instance, the moment I look upon something as being somebody, I am lost to science: you can only introduce a somebody into an equation by turning him or her into an "it." If then our common sense has nothing to do with equations, how do we manipulate these not-to-be-scaled patterns?

The point happens to be brought out in the columns of *The Times* of London to-day. The Rev. Prof. C. F. Burney is arguing with the General of the Salvation Army about the truth of the Fall of Man and Original Sin. He says: "To suppose, however, that recognition of the mythological origin of the outward setting of these Hebrew narratives carries with it their 'scrapping' as the media of spiritual truth surely involves the crudest of misconceptions as to their purpose. The writers were actuated primarily, and mainly, not with the teaching of history or physical science, but with the teaching of *religion*. If once we lose sight of this fact, and think that we are to go to them for exact historical information, or for accurate scientific knowledge, we are certain to go wrong and to be disappointed. For it is in the sphere of religious truth that the inspiration of the Old Testament is to be found. The writing in which the truth is contained, whether it takes the form of history or any other form, is merely the human framework, and as such, subject to the limitations of human method."

This is not a remarkable piece of reasoning,—except perhaps for its inconsequence,—but it brings out very clearly the point that a positive value is attached to what is admitted to be scientifically untrue: it has value, in this

case, as religious truth. Now how can scientific untruth be in any sense truth?

Let us (ignoring the complication that is due to the use of the word *truth* in two contexts of this kind) take an illustration. If I want to start a horse I say "Gee! Up!" and in all probability the horse will move on. If I want to start a car, will "Gee! Up!" serve? Why not?

Now a car has no soul: we treat it scientifically: we don't (unless we lose our tempers) omit the scales by which we can foresee its reactions. We shall sooner or later get into serious trouble if we cannot name and scale various patterns inside the car. But the horse has a personality and, though we know something about horses, we are always up against something unique when we are dealing with one horse. It has been discovered empirically that a horse will react in certain ways to certain expletives. If we visit our horses by night, we know that it is wise to "say something" as we enter the stable to reassure the horses. We have, then, in addressing our cars no words; we act—if we can. In our intercourse with horses we act too—in so far as they are treated as machines: but we recognize the "soul" in them, and work on that with meaningless words. It will be admitted that we do much the same with young children: even with older children: even with adults —as, for instance, in times of war. We shout "The Hun is a pig" or "Allah is great" or "Death to the Foreign Devil": we do not claim to be "actuated primarily, and mainly, with the teaching of history or physical science, but with the teaching of" patriotism. Unfortunately this claim that we don't mean what we seem to mean is a very dangerous one. If I could persuade your horse that when you say "Gee! Up!" you don't mean anything, he might learn to pay no attention. Expletives are useless unless the target at which they are aimed reacts to them: and inanimate (or soulless) targets cannot thus react. Hence

the first condition: expletives (or common sense)can only be used with individuals (souls). The second condition is: expletives need mean nothing, or they may seem to mean the opposite of what they say: but expletives are useless unless the soul aimed at reacts to the expletive in the desired way.

We have used the term "expletive" purposely: it evidently covers only a very small portion of what is meant by common sense: but it serves to emphasize the very great difference between the language that is used for persuasion and small talk and propaganda of all kinds and the language of science: it also serves to remind us that we have much more to do with "souls" than with science: and the tact which suggests to a man the right expletives to use in any given situation is rightly considered a very valuable asset. Much has already been done to reduce the art of using expletives to a science (crowd management, factory management, the mind of the heathen and so on) It is a complicated question: we have to discover what noises will produce desired effects under given circumstances: and a study of the expletives used during the last general elections in England makes it quite clear that the personality of the speaker must have something to do with it too: it is not right to say that the public will swallow anything: every public requires the right expletives from the right fellow at the right moment. Given those, expletives are indeed (as Kipling once said when speaking of those expletive manufacturers usually called poets) words that walk up and down in the heart of men.

We suggested that this might be made a part of the philosophy teaching of universities. But only in this way: before a degree or any kind of certificate of proficiency for philosophy be awarded, the professors or examiners or both should have satisfied themselves that the candidate has had practice in the use of nonsense, common sense,

expletives or whatever else we choose to call this very human, very important and very unscientific procedure.

Philosophy is an exacting study: it is apt to cause melancholy: hence it should be not only a maxim, but a condition of qualification that a student should not fail "amidst his serious studies and business, to use jests and conceits, playes and toyes, and whatsoever else may recreate his mind." Intercourse with fellow beings or with animals, not theory, teaches how to use words in this meaningless but very effective way. It is far too often assumed that language is, as a rule, used scientifically and grammatically: there are languages that are, as a rule, used thus; for instance the language of mathematics, the language of chemistry; and the notations of music and of phonetics and certain conventions of commerce are accurate. But for the most part words, even in much that claims to be science, are (like an otherwise useless kind of egg) for electioneering purposes. It is the rarest thing to find any one *convinced* in a debate: we start an argument and are not in the least surprised if both sides retire with the conviction that the other side has been talking nonsense: this may very well be so: but our purpose sometimes is to arrive if possible at a conclusion, which is not to be expected unless we start with "given this and that, let us see what follows." Far too often we start from different points of view: the result is as satisfactory as if you and I sat down to play a game, you with chessmen and I with draughts. The trouble is largely due to a failure to distinguish between these three kinds of "knowledge"; in the next section we shall attempt to distinguish between the products of "knowledge," which are usually all grouped under one name "truth," which, in consequence, is an ambiguous term. Let us call the knowledge of pure philosophy K1; of science (i. e., equations) K2; of common sense

(efficient expletives) K3; and let us see how the "truth" derived from them differs.

VIII.

Bishop Berkeley says that the physical universe which is seen and felt and inferred is just a dream—your dream and mine and nothing else; only it so happens, he says, that our dreams agree in many respects. It is natural to inquire how it "so happens."

We have already seen that in practice we deal with three kinds of so-called knowledge: the fact that one name is applied indiscriminately to all three, has been the source of much misunderstanding. There is, firstly, the knowledge that all knowledge is of symbols, these being the tangible signs which stand for a fictitious relation between otherwise incomprehensible variables—a relation that is assumed to be constant until the deductions from such an assumption are seen to be unsatisfactory. This is K1. There is, secondly, the knowledge we gain by assuming the equivalence of symbols as if they were constants; by ignoring the variables in the equation as negligible quantities we get what is in theory highly illogical but in practice most useful and fruitful—a fictitious decomposition of the infinite. This is K2. There is, thirdly, the knowledge which we gain by emphasizing the variability of the values of symbols (positing, in fact, individuality) and treating them as a man aims at a moving target. Using the words strictly, this knowledge is instinctive and emotional—K3.

Now if in Pure Philosophy there is no truth, if the burden of it is that we can know nothing, it may be objected that if we know nothing, we cannot know that we know nothing. That this objection should so often be a stumbling block is due to an impetuous belief that language will bear any weight: like children skating, we may forget that there are spots which will not bear.

What is meant by saying (idiomatically) that we know nothing is similar to what is meant when we say (again idiomatically) that "there is nothing in that box." This statement, taken literally (as the objectors to our original statement take ours), is absurd: a box with *nothing* in it is not what we really mean: we mean that it is a box with *something else* in it—not the something we were thinking of. Likewise, if I say I have no knowledge of things—that I know no thing, I do not mean that I am daft, but that what I know is *no thing* but some relation. I skate over what is like a frozen surface with great ease and profit: language is, as it were, the ice: you may emphasize, if you will, that language represents reality, as ice "represents" water: no one can reasonably deny that, as we have a body of water under a frozen surface, so we have "reality" behind language: at the same time if you fall in—that is, if the ice gives way—your skating is over and it is a matter of saving your soul alive: so if language gives way and we fall into "reality," our thinking is over and it is a matter of saving our sanity.

Or, to put it another way: I may know nothing about the contents of two bags: but I may know how they behave on the scales: if one is heavier than the other, I can discover what should be added to the one to make it equal to the other, and so on. Words (or the patterns they present) are like such bags: we can do great business with them: but we can never open them: in fact it is only the over curious who ever wonder what is inside them: they cease, in practice to be bags at all, they become weights, and most of us would answer, like a trader asked what was in his pound weight, "why, it's solid."

If, then, of truth there are three kinds, let us use three distinct symbols: the three kinds of knowledge will produce three different results.

Let us keep the word TRUTH as the name of the product

of K2. As the product of K1 is a less generally useful kind of truth, let us lop off the first letter and call it RUTH. And as K3 produces a kind of truth that posits the soul, or personality, let us add one letter (a relic of an old expletive) and call it STRUTH.

RUTH, the product of K1, must have taken many centuries of thought: we find it complete in the Upanishads. It is reached, like truth, by the gradual elimination of the self, the soul, the personality, until we get such expressions as the Impersonal Self. If we express it mathematically it is the equation

$$\text{Everything} = \text{nothing}$$
$$\text{all} = 0.$$

It looks useless enough: but it shuts out a number of perplexing problems. That equation is to us, what the bars of the cage are for wild beasts in the Zoo. We take this as granted: we become reconciled: we recognize our bearings. We shut our eyes to the discrepancy that must always exist between *this all* and *the all,* and we assume that we may, for instance, say

$$\text{this all} = \text{all that}$$

and disregarding the fact that all = 0, we continue

$$\text{this} = \text{that.}$$

On this equation (and this assumption) is built up the whole of science, or what we have called TRUTH.

But scientists are often human: we find them using, for instance, such phrases as "*E pur se muove.*" This is not merely a statement of truth: the author is betraying certain διαθέσις ψυχῆς; the phrase may contain truth: but it also contains something of the nature of an expletive, something of the emotional attitude that introduces the name of God; we have, in fact, a clear streak of STRUTH as well as TRUTH.

Our ignorance of the origins of language is immense;

but if we keep clearly before us the difference between the pattern (or the "thought") and the label (or the expression) we are tempted to suppose that in the most rudimentary stages the pattern was highly individual and personal, and the expression purely expletive. A dog's patterns must represent a very advanced stage of composition and intellectual comprehension. We may reasonably imagine a dog being continually in the attitude of asking "Who is that smell?" or "Who is that noise?" or "Who is that patch?" The expression of his thoughts, which may be too subtle for us to analyze, seems monotonous. In other words, the dog has a "language" that is highly ambiguous. We are told that in Brazilian the one word *tuba* may mean his father, or he has or he is a father, as if this were a peculiarity of a primitive language. We might as well conclude that French is a rudimentary language because the word *à* requires no less than twelve columns in Littré's dictionary. It is a very bad (but very natural) mistake to suppose that because an expression looks awkward to us, it *is* awkward. The phrase "rudimentary language" is useless. We have to deal, on the one hand, with patterns of *thought*: these we call rudimentary if they strike us as inferior to our idea of highly developed patterns of thought. It is open to Gough to say: "the Upanishads are the loftiest utterances of Indian intelligence. They are the work of a rude age, a deteriorated race, and a barbarous and unprogressive community."[1] My dog has every right to say the same of my work, and he could say it in one word. On the other hand we have *expression* which is more or less convenient (and convenience is largely a matter of habit): the Greek particles are a curse to some minds, the Russian verbs a puzzle to others, such phrases as the Japanese: *Inu to iu mono wa,* or the French: *qu'est-ce que c'est?* may seem to foreigners absurdly cumbrous; on the other hand, a

[1] A. E. Gough, *The Philosophy of the Upanishads*, 1882, p. 268.

himalayan amount of meaning is often carried by one word in all languages: it is only relatively convenient to use such expressions as *sour grapes* or as the Japanese proverb *Hotoke no kao mo san-do,* which Chamberlain translates by "Even a Buddha's face can only be tickled thrice" (or the crushed worm will turn). It is not necessary to multiply examples. Expression is clearly convenient, good, beautiful, highly developed and so on, only if it happens to take the judge's fancy. But thought and expression may always be classified as colored or colorless. "Color" is the result of the intrusion of personality. This subtle change, as if the sun suddenly shone on the words, may be seen as follows: in languages (such as japanese) that have no relatives we get phrases like *"Yesterday came man,"* for the thought we express by *"the man who came yesterday."* At present this phrase is colorless: it is a term that might enter into an equation. But if we invert and, instead of saying *"the man who came yesterday,"* say *"who came yesterday? —the man"* (this is perhaps the earliest form and origin of the relative) we at once introduce the presence of a speaker and a hearer. When a child says *"Three sevens are twenty-one"* we call it truth. When it says *"Three sevens are twenty-one, aren't they?"* we have that perplexing expletive, which turns colorless truth into a highly colored specimen of struth: and the answer whatever it is (unless the child happens to have an exceptional parent) will mean something like *"I think that is what we said before."*

It is perhaps impossible to prevent the language that is in common use from being colored. If the Buddha and Socrates had invented new symbols for their thoughts instead of using chameleonlike symbols which everybody thought he understood, we might now be able to write the history of two sciences, instead of having to write the history of two religions. Geometry has been made possible

because (though even here color has crept in) circles and points were called A, B, C, or D. All serious sciences have had to fall back on a specialized form of expression which gave an impersonal quality (as far as this can be done). How dangerous ordinary language is may be seen if we consider a common opening to mathematical expositions: "Let. . . ."—here is already a flavor of struthfulness: all imperatives presuppose two (at least) persons—like our expletive "Gee! up!" It seems likely that, in early forms of speech, there were words like "up" that stood for a command when the observer was feeling aggressive or a noun when the aggressor was feeling observant, as for instance in face of a steep hill which he wished to get to the top of. Be that as it may, our scientist would be well advised to leave out even such apparently colorless words as *if* (*given*) and express in a strictly colorless symbolism his successive steps

$$\begin{aligned} &(1) \quad a = 3b \\ &(2) \quad a = 2b + b \\ &(3) \quad a - b = 2b \end{aligned}$$

To sum up: there are three kinds of truth and three kinds of knowledge. What we have called TRUTH is got by equations and the elimination of personality. There are two ways of eliminating the color of personality (1) by turning out the light altogether and getting darkness: what we have called KI and RUTH; (2) by getting a pure white light (as it were by fusing all personalities into impersonality) which may indeed (either intentionally or unintentionally) be split up, but which, the moment it shows traces of the color of personality, ceases to be TRUTH and becomes what is, scientifically considered, nonsense; socially considered, that very valuable and illogical kind of logic known as common sense or, as we prefer to call it, STRUTH.

IX.

If we drive analysis right home, pure philosophy leads to nescience and everyday language to non-sense. The language of science produces sense by the use of equations based on the fundamental assumption that we are justified in saying *this* = *this*. It must not be supposed that this is anything more than an assumption that is justified only because it is, within its limits, true enough. Much confusion is bound to arise the moment we assume that *this* is indeed equal to *this*. We have seen that every *this* has an infinite remainder which we can, up to a certain point, afford to ignore: it is therefore clear that, even in the department of knowledge to which we have limited the use of the term "truth," we are able to proceed only because we refuse to recognize, on either side of the equation, the presence of immeasurable variables. The equation should be *all this* = *all this*: and it is by dropping the *all*, with which we cannot deal, that we can conveniently handle the *this*.

If I say that water boils at such and such a point, and always boil my water in the same room, I may not discover that this truth is only true enough; but, if I boil my water high up in the mountains, I shall find errors in my calculation, because part of the infinite remainder has become relevant, showing that our *this* = *this* is no longer true, because our *this* was too strictly defined.

In the same way it has been assumed that time and space could be treated always as if 1 hour = 1 hour or 1 yard = 1 yard. Within limits—and the limits in this case have only recently been reached—these assumptions are true enough. But it is often forgotten that they are assumptions which can only be treated as absolutely true for the sake of convenience.

The statement that this is not really equal to this is described sometimes as outside common sense. This is

precisely what it isn't. As we have seen it is science and not common sense that affirms that *this man* is the same as *this man*. The statement is a palpable fiction, which common sense is far too wary to assume: it is much safer in practical life to emphasize the variables and to act on the principle that *this* may have been a very good boy half a minute ago, but there's no telling what *this* may be in half a minute's time. Ladies, too, know quite well that a dress in a sense remains *the same*: but is it the same on her? Two men use the same words: are they the same? It is amusing to find commonsense accusing science of talking non-sense when science has for a moment allowed common sense to intrude into the field of fiction in which it is wont to work.

W. O. BRIGSTOCKE.

LONDON, ENGLAND.

A MECHANIC ON THE "MECHANISM OF THE BRAIN."

FOR many years it has been evident that our bodily organs, our kidneys, stomachs, toe nails, are complicated mechanisms of the same type, though of vastly higher degree, as storage-batteries, engines or other mechanical manifestations of physical and chemical laws. General physiology has made marvelous advances in recent years, in explaining many of the details of the identity. Extension of these ideas to mental processes has been made by some psychologists and by some mechanistic philosophers. These ideas have not, however, gained the currency which they should and are by no means as universally admitted as they should be.

Furthermore, there is a vast gap in all analyses of the mental mechanism with which I am familiar, between the furthest advance which physiology has made in actual analysis, and the study of the actions of the complete machine with which most psychologists and philosophers begin. I am neither a philosopher nor a psychologist nor a physiologist, but am familiar with the grosser forms of machinery and have had experience with the analysis of material mechanisms. I feel that my point of view is useful in such analysis of the mental mechanism as will fill up the gap mentioned, as well as in the giving of more currency to mechanistic methods and elimination of "psychical" things beyond the domain of physiology.

I have tried to be very conservative, to be tolerant of other view-points in the matter, and to be duly judicial in all of the discussion. I feel, however, that the future will show that much more radical statements are justified.

I. INTRODUCTION.

The Vast Difference in Scale of Natural Phenomena.— As a beginning, we emphasize the commonplace that difference in degree does not necessarily mean difference in kind. The undisputed fact that the operation of the brain is complex beyond all conception does not of itself prevent us from putting it in the same class with the vastly simpler mechanisms whose operation we relatively understand. For instance, we can lift and form a conception of small masses. We can build cranes and lifting-mechanisms which handle masses weighing many tons. We can learn of the vastly greater mass of some of the planets, or of our own sun. We can read the astronomer's accounts of other suns with still greater masses. The ratio of the mass of such a sun to a mass which we can lift is a number with such a long string of 0's, that we have no conception of it. There is a similar situation in the descending scale as we go from a mass which we can lift to individual crystals, to molecules, to atoms and to electrons. Yet the mass of an atom is the same sort of thing as the mass of a distant sun even though there is a difference in degree beyond all conception.

We can measure and have an intimate knowledge of an inch or a foot, and can have a vague idea of the distance to the moon. There are successively greater distances to the planets, to the fixed stars, and to other stellar systems, distances which light travels in a hundred thousand years. In the descending scale there are the thousandths and ten-thousandths of an inch which a mechanic can measure, the lengths of light-waves which a physicist can measure and the interatomic distances which a physicist can compute.

The ratio of the least of these distances to the greatest is again a number beyond conception, yet they are of the same kind and differ only in degree.

The machines which we know and can understand have enormous differences in complexity. A person not versed in mechanical matters has intimate knowledge of simple machines, such as a can-opener, or a crow-bar, but no real working knowledge of such a machine as a clock. Farther up in the scale of complexity are machines such as those for setting type and for printing and folding newspapers. The design and construction of such machines can only be handled by persons with great natural ability for the subject and long training in it. Without meaning any disrespect, I venture to say that the average psychologist will grasp with difficulty the intricacies of a modern high-speed newspaper press. A further step in complexity is the cell-system of a low-grade plant. Successively further along in the scale are the organizations of a high-grade plant, of a low-grade animal, of a frog, and so on. There is no reason *per se* why we should assign any other difference than that of degree when we finally come to the human brain.

The intricacies of a modern newspaper press may bear the same ratio to the intricacies of the cell-system of the brain, as an interatomic distance bears to the distance to the farthest misty nebula. We call the latter things "distances" even though they differ in degree beyond all conception. Why may not the former things also be in one class even though they too differ in degree beyond all conception?

Historical Advances in Mechanical Conceptions.—For many centuries our knowledge of the physical world was that obtained by the speculations of philosophers, based upon the gross evidence of our senses. But presently we

found that the earth was round even though it appeared flat to our senses, and that the earth moved even though it looked as if the sun did. We once believed that the lightning was caused by the wrath of the gods and we peopled all nature with spirits. We must admit the possibility that we have been doing similar things in connection with the processes of the mind. We must hold ourselves ready to advance as far beyond the conceptions of mental processes held by the Greek philosophers as we have in the conceptions of physical processes. Just as we have substituted osmosis, cell-chemistry and other elements of a completely mechanical theory for the idea that there is a nymph in every tree, so we must not hesitate, if need be, to make similar advances with higher forms of life.

Aptitude for Studying Mechanisms.—The conception that the earth is round was a difficult one for all but a very few when the doctrine was first promulgated. Even yet the minds of children and of lower races cannot grasp it. It is only because it has been made familiar to us by experience that we entertain it without doubt. Similarly, it is comparatively easy for one who has been brought up with machinery and who has worked with and studied successively more and more complicated pieces of mechanism, to throw over non-mechanical conceptions and to believe that the brain is a complicated machine. I feel that a psychologist in order to give these matters intelligent consideration must have some such mechanical aptitude. The true mechanic has a keen delight in viewing a new type of machine, in watching it perform its various functions and in studying the methods by which it operates. The designer whose brain has given birth to a piece of mechanism has an indescribable pleasure in starting it up for the first time and watching its operations, if it so be that the machine runs successfully the first time. More

often, there is birth travail and painful labor before successful operation is obtained. The glory of the final success certainly equals that described by painters and sculptors who have completed masterpieces. Something of this mechanical point of view must be understood by one who would make progress in the present discussion. The properly prepared mind has no difficulty in taking up the hypothesis that the brain is nothing more than a vastly complex mechanism, and discussing all of the arguments pro and con in a sympathetic way.

In the present study of the mechanical brain we are in the position of a mechanic who must analyze a complicated machine merely by external observation and by examination of the effects produced. It is as if he must explain a printing-press by examination of the external wheels and levers and by seeing the paper fed in and the printed sheets discharged. However, nerve and brain physiology is making rapid advances and some day will give us a good idea of the internal brain-processes.

II. MACHINES IN GENERAL AND MEMORY IN PARTICULAR.

Mechanism of Memory.—With a conception of the possibilities of mechanisms and with a mind untrammeled by ancient philosophy, let us begin by discussing the phenomenon called "memory." Somewhere and somehow the brain makes a physical record. In this, as in most other parts of our subject, there is no physiological knowledge as to how this is accomplished, so far as the writer knows. Nevertheless, there must be a definite memorandum of everything we remember, of the nature of a phonograph record. It is easy to make a mechanical theory of the action. An original environment is "perceived" by our senses and some sort of a wave or pulse or other transmitting action proceeds along sense-nerves and directly affects certain brain-cells so as to cause some sort of reac-

tion. The mechanism of the "perception" and "transmission" is not our immediate purpose and will be discussed later. The effect on our brain-cells we call "consciousness," the mechanism of which we also will discuss later. For the present we need merely note that "consciousness" consists of some sort of physicochemical action on brain-cells. That is to say, certain cells out of the vast group in the brain, connected to certain sense-nerves, are oxidized, or nitrogenized, or ionized, or electrified, or made to attract or repel each other, or to have their molecules or atoms or electrons rearranged through electrolysis, or affected in some such way, by the pulse transmitted by the sense-nerves. The exact action is complex beyond all possibility of conception at present. At the same time that the "consciousness" is produced, the pulse passing along the sense-nerves also makes a record of itself, by sensitizing or energizing or creating certain "memory-cells," which record is preserved and stored up.

When the remembrance is later called into action by admission of blood into a particular channel, or expansion and contact of a particular nerve, or some such physical connecting-up of a particular group of memory-cells by association, it simulates or reproduces the sense-nerve reaction on the brain-cells by producing on them a physicochemical action like that produced by the original consciousness. That is to say, we may define "memory" as a stored-up record produced by the sense-nerve pulse at the same time it is producing the physicochemical action called "consciousness," which is later rotated into the field of action or recalled by association, and then simulates or reproduces the effect of the original sense-nerve pulse, which results in reproduction of the original physicochemical action or consciousness. The muscular and other reactions initiated by the original or memorized consciousness we

discuss later and for the present confine our attention only to memory.

Memory does not reproduce an original environment, but does reproduce the mechanical impressions which the environment produced. There are a number of familiar machines which act similarly. The phonograph recorder is subjected to the environment called singing and reacts to it so as to preserve a record which later, when the record disk is inserted, yields "sounds" which impress the atmosphere, our sense of hearing, etc., as being a reproduction of the original particular environments, and which initiate effects such as vibrations of the room walls, pleasure on the part of the hearer, etc., just as the original would have done.

A photographic plate with proper lenses reacts to an illuminated scene so as later, when brought out and held to the light, to yield a picture which impresses the surrounding light-wave medium and our sense of sight as being a reproduction of the original scene. So the sound-waves given out by some one speaking to us are transmitted by the ear-sense and the hearing nerves to certain brain-cells which give "consciousness" of the sounds; as well as to certain "memory-cells." These latter preserve a record which later, when association recalls it, impresses the brain-cells as being a reproduction of the original consciousness of the speaker's words and which can cause us to act as if we were hearing the words. In other words, we "remember" what was said and act as if we really heard the speaker. I say to the servant, "Close the window at once," and he reacts accordingly. The environment produced by the sound-waves of my voice reacts so as to directly initiate certain motions on the part of the servant.

On the other hand, I say to the servant, "Close the window if it rains while I am away." A record is made by his memory-cells. Afterward, if recalled by the presence of rain, the memory-cells produce the same physico-

chemical action on other brain-cells as my direct command would have produced and the motions which close the window are indirectly initiated.

The conclusion sought is that it is a purely mechanical matter to store a record of an original environment, such that there is later reproduced not the original but an effect the same as produced by the original, and which effect initiates reactions the same as did the original. The memory does no more than this, so that it does nothing that cannot be explained on mechanical grounds.

The mechanism of memory has been used as an introduction because it seemed to have the nearest mechanical analogies. Indeed, it might have been admitted by present-day psychologists that storage of memories is a mechanical operation, because of general familiarity with phonographs, cameras and the like, without the preceding discussion. This would not have been the case twenty years ago, however.

Nature of a Machine.—Before proceeding with further examination of the machine-like action of the brain it will be well at this point to define what is meant by a "machine." A machine is an organization which reacts to its environment in a manner governed solely by the natural laws of physics, mechanics, chemistry and the like, as applied to the condition of the machine and the environment of the moment.

The well-known mechanistic philosophy makes the point of the ability of an omniscient being to predict the action of all machines for all time. I am rather vague as to what "omniscient" means so that I do not desire to make this particular point. However, I suppose it may follow from the definition.

The point I do desire to make is that all of the reactions of a machine to its environment are purely matters of

natural laws, some of which we study in our text-books and many of which we do not yet know.

The waves dashing on a rockbound coast form a machine, and the shape of the spray clouds, the form of the billows and the sound of the beating waves, all follow directly from the shape of the rocks, the intensity of the wind and the occurrences out at sea which started the waves, all acting according to the law of hydraulics. There is no reaction other than that produced by these laws of hydraulics as applied to the particular rocks and air and water molecules at the instant.

Our thesis is the demonstration that the brain is a similar sort of machine, of course of extraordinarily complex character. There are various cells consisting of carbon, hydrogen, oxygen and other elements, each minute portion containing billions of atoms and electrons arranged about each other in many different ways. Each atom is a planetary system which reacts on its neighboring atoms according to laws of radio-activity, molecular attraction and what not, so as to produce vastly complex molecules of all kinds which in turn form cells of various types in an endless variety of permutations and combinations. The cells of the brain are affected in various ways by the blood and by secretions from the glands which circulate in the blood and by the sensations transmitted to them from sense organs, and by the food, chemicals or narcotics which have been taken into the body. These various things oxidize or reduce, or have various physical or chemical actions upon the cells so as to affect them in various ways, and the net result is a thought or a muscular action or the driving of a nail or the writing of a word. I have no doubt that in due time physiologists will analyze all these effects in great detail. Even now we know the ultimate effects of many things on the mind though we cannot yet analyze the exact mechanisms by which these effects are produced.

We know that alcohol has a chemical effect on the brain-cells which produces the well-known mental actions of an intoxicated man. We know that opium produces certain pleasant thoughts. We know that when a female animal is "in heat" the secretions from certain glands cause tolerance of the opposite sex. We know that certain stomach secretions produce nightmare, and so on ad infinitum.

Many modern psychologists will probably admit the doctrines mentioned up to a certain point. For instance, they may admit that a plant is a machine but will claim that something beyond the laws of physics and chemistry separates plants from animals. Some may go a step further and admit that the starfish or sea-anemone or some other lower organization of cells can be explained purely by physics and chemistry but invoke extraphysical laws beyond this point. Still other psychologists draw the line between the brains of brutes and the brains of human beings. I draw no line whatever and will attempt to show that even reasoning is mechanical.

III. PERCEPTION AND CONSCIOUSNESS.

Mechanism of the Perceptive Senses.—Next we will consider the "perceptive senses." In spite of any opinion to the contrary, everything that reaches our consciousness from external sources does so by purely mechanical means. All of the senses, by means of which we learn of our environment, are mechanical systems acted upon by mechanical agencies. Psychologists have made good progress in explaining the initial mechanism of many of the senses. We know a great deal, for instance, about the mechanism of the ear and how a sound-wave, by means of the apparatus of the inner and outer ear, starts the pulse along the nerves between the ear and the brain. Similar progress has been made with some of the other senses. The point I desire to make here is that all of our thought originates

in a mechanical way. The music-lover who is thrilled by a symphony had all of these feelings created by compressions and rarefactions of the atmosphere extending from the musicians to his ear. The rhythm and color and the beauty of the music are nothing more or less than the way in which the sound-waves follow each other, the number of different types of vibrations or harmonics produced at the same time, the relative intensity of these different harmonics, the speed or change of speed at which they are produced, and so on. There is no mysterious communion between the soul of the musician and the soul of the hearer, but simply a great number of sound-waves produced as a result of long technical experience on the part of the musician. A good violinist has no more soul than a poor violinist. He simply knows how to bow his strings so as to produce sound-waves which go faster or slower or have more harmonics, etc., so as to affect the ear-drum of the hearer in a slightly different way. There are many who do not thrill and have ecstasy when they hear a good musician. This means either that the mechanism of their ears is not fitted to react to all of the complexities of the sound-waves, or else that the brain-ends of the ear-nerves do not communicate the same impressions to the various brain-cells.

A picture-lover, who receives inspiration from a sunset or from the painting of a great artist, merely receives on his retina a number of bands of color, transmitted by a very complex system of light-waves from all parts of the scene. The entire perception is mechanical and not etherial or mysterious.

The "sense-nerves" or "perceptive nerves" or "afferent nerves" are those which convey pulses to the brain. They are the avenues of "incoming messages." The occurrences at the beginnings or other sensitive centers of these nerves, we define as the "environment." This environment may

be light-waves of various sorts, sound-waves, chemical or mechanical effects of various sorts affecting the "tasting nerves" of the tongue, gaseous actions affecting the olfac tory nerves; heat, cold and mechanical effects which affect the touch-nerves; position which affects the equilibrium-nerves of the inner ear, and other agencies whereby that part of the universe distinct from a being, has an effect which initiates a pulse which is transmitted to the brain. We also include in the environment the perceptions of nerves with internal termini or sensitive centers, such as hunger or satiation of the stomach, the effects of inflammation, abscesses and other internal evils, the effects of toxic products of exertion called "tiredness" and other similar effects whereby occurrences internal to the being are transmitted to its brain. The pulse along the perceptive nerves produces a reaction in the brain-cells at the nerve-extremity which we call "consciousness" and which is next discussed, as well as "memory" already discussed. Mention has often been made of the similarity of this nerve-transmission cycle, between perception and consciousness, to telephone or telegraph or wireless systems. The mechanical nature of both perception and nerve-transmission is generally agreed to.

Consciousness. — The pulse at the brain end of the nerves next causes a brain-cell reaction. A further step is often discussed, the transformation of these cell-reactions into "ideas." There is, however, no reason to postulate any transformation. That mechanical reaction produced on the brain by the pulse from a perception is itself the idea and the matter goes no further. The same perception produces the same mechanical reaction every time, and is the thing we associate with the environment which produced the perception.

A certain environment produces "cold," and after perception and nerve-transmission, brain-reaction of a certain

type occurs. This is the symbol or representation of the cold and is its ultimate effect.

By means of the memory we identify this with previous reactions of the same kind. The kind of reaction in question together with the memorized association with similar previous reactions is the entire substance of our "idea" of cold, and there is no further mental or superphysical process or transformation. When we view a scene with the eye, our outer eye mechanism makes an image on the retina. This part of the process we well understand. We have even made photographic cameras which are good models.

The image on the retina affects countless nerve-ends and is transmitted to countless brain-cells. The resulting group of vibrations or cell-actions or whatever other reaction occurs, constitutes the ultimate mental effect of the scene.

Hence we define "consciousness" as the mechanical or physicochemical reaction produced on the brain-cells by the sense-nerves as the net result of sense-perception of an external environment, and symbolizing or representing it. There is no further transformation to which the term can be applied.

There are many mechanical analogies to this conception of consciousness. A rock lying on the ground reacts to its environment and to occurrences which go on in the world around it. If it is hit with a hammer, vibrations are set up and the fiber of the rock moves to and fro through a slight amount, as is made manifest by the sound-waves. If the sun shines on the rock its parts react in a way which we call "rise of temperature." If a sufficient force is applied the rock moves from one place to another. So in many ways various occurrences in the world surrounding the rock affect it and are "perceived" by it. Is there any difference except a vast one of degree, between these reactions or perceptions and the perceptions of the

human brain to occurrences round about it? Part of the difference in degree is the immeasurably complicated mechanism by means of which the perceptions are received and transmitted to the ultimate brain-cells, as compared with the crude system of the rock.

IV. OUTLINE OF THE MECHANICAL BRAIN.

Philosophers, Mechanists and Vitalists.—At this stage of our development of the conception of a "mechanical brain" it will be well to consider its relation to the old debate between mechanists and vitalists.

A mechanist must of course have some such conception of a mechanical brain as is here presented, but a vitalist might also admit it. Presumably a vitalist has no repugnance to a mechanical kidney, where the entire operation is a matter of chemistry and physics of the various cells and juices and secretions, after the process is once set in motion. From this same point of view a vitalist can tolerate our mechanical brain whose cells and secretions are subject to similar purely physical and chemical laws after the operations are once started. Presumably a mechanist must also have some "ultimate cause." We can have no conception of a machine which was not made by a mechanic. However, we need not reach conclusions on any such questions. We can discuss the mechanism of the brain without drawing any conclusions in the general philosophical problems of mechanism versus vitalism, ultimate causes and the like. Indeed, such conclusions may be wholly beyond us, just as conceptions of its manufacturer are beyond a printing-press.

We therefore may content ourselves with the admission that we have somehow or other, with an origin which is not our present problem, a "physical universe," which is a system of mechanical, physical and chemical elements reacting according to certain chemical and physical laws.

That is, we postulate, without philosophical discussion, that there is a natural world full of atoms and molecules and cells, reacting according to a fixed code of laws, and external to the thing we call the mind or "brain."

The "mechanical brain" is, then, merely an assembly of molecules in such a world, and is the same sort of thing as a rock or a lake or a glacier or a coconut or a printing-press or any other assembly of molecules reacting upon each other and upon their environment according to the circumstances of the minute, and the code of laws. We discuss the composition of the rock or the theory of the glacier or the action of the kidneys in health and disease without introduction of philosophy of ultimate causes, and the mechanism of the brain can be discussed in the same way.

We can trace the action and interaction of the wheels and cams and levers of a printing-press, without consideration of the ultimate constitution of the matter composing the parts or the fundamental difference between an iron or copper atom or how either atom originated, and without philosophy of any kind.

Similarly we may discuss the physiology of the mechanical brain, and in time learn of its action just as we learn of the action of a printing-press. We can do this without ever raising the question as to whether or not we are so finite that it is fruitless to philosophize more deeply.

We will find that we can account for all of the occurrences without recourse to superphysical or psychical actions. True, the physical and mechanical actions are extraordinarily complex but we will find no reason to suppose that they are anything other than complicated manifestations of laws whose simpler aspects are familiar to us.

Résumé of Mental Actions.—We may now resume our analysis of the brain-mechanism from the point previously

reached where a cell-reaction called "consciousness" was produced at the end of a cycle of mechanisms beginning with sense-perception of an environment.

We have discussed the mechanism of the memory which has power to give reproduced consciousness.

The successive reproduction of past environments by such reproduced consciousness we call "thinking." This action we will examine in detail at a later point. As a result of present and past environments, that is, of the sense-perceptions of the instant and of remembrances called into action by "associations" which we also discuss later, there is produced a resultant consciousness in the cells at the ends of the sense-nerves. When these cells are thereby sufficiently charged or saturated they excite a corresponding combination from an adjacent group of cells at the ends of muscle-nerves carrying "instincts" and "habits," and we have an "impulse" to act. This effect we also consider in detail later. The instinct- or habit-cells, when they are thus excited, act on the attached muscle-nerves, which transmit a pulse to certain muscles. These then execute that action which corresponds to the excitation of the particular instinct- or habit-cell combination. We here only mention the relation of these actions to each other as an introduction to detailed study of each of them.

We pause for a brief and final mention of the "muscle" or "efferent nerves" which transmit pulses or "outgoing messages" from the brain and which cause such chemico-physical actions at the nerve-ends as produce muscular motion. It is generally admitted without question that the entire action is mechanical so that we need not devote time to this point. The action is more or less similar to that of the pulses along sense-nerves already discussed and has similar mechanical analogs, such as telegraph or telephone transmission.

The important point which we propose to demonstrate is that the "impulse" to act is a purely mechanical correspondence of a certain one of the untold millions of possible combinations of reactions of the cells at the ends of the incoming nerves which carry consciousness, with one of the equally numerous combinations of reactions of cells at the brain-ends of the outgoing nerves which initiate action.

A very crude analogy is the "player piano." In it, the environment consists of the rate at which the music roll is fed, the adjustments for intensity of the sound and the various other manipulations of the operator. These with the record made in the past, represented by the perforations of the music roll, and corresponding to memory, cause a combination of conditions remotely resembling consciousness. This combination initiates an effect on a certain combination of mechanisms which results in the sounding of a musical chord. There is a remote resemblance between such an initiation and an "impulse"and between the sounding of the chord and an "action."

Another analogy is the "relay" often used in machinery. An incoming effect, such as the motion of a governor in a steam-engine, or a long-distance telegraph message, is not itself transmitted, but serves to actuate the relay mechanism, such as the application of power to the engine-valve mechanism or the telegraph relay-sounder, and this relay mechanism then performs such action as corresponds to the original excitation and the relay structure.

The brain-cell system which receives the impulse from a consciousness and which starts a pulse along the muscle-nerves has an inherited structure which inevitably produces certain actions called "instincts." Through the influence of environment, other actions called "habits" may be "learned." We proceed to the detailed discussion of these matters.

V. INSTINCTS AND HABITS.

Instincts.—A man or other animal which is born with the brain-cells which perform the cycle just outlined, has what are called "instincts" to perform certain acts under certain circumstances.

As an introduction to the discussion of this matter, consider the systems of cells which constitute the hairs of a leopard. The prehistoric leopard was born with a nucleus which, with proper nutrition, grew into a certain hair system. Then the wonderful occurrences of evolution, such as the "law of natural selection" and "survival of the fittest," began to take effect. Thus a system of hair-cells was finally evolved which is either neutral or helpful to existence. Each modern leopard is born with an evolved nucleus which inevitably grows into a general hair system resembling that of all other modern leopards but nevertheless having individual peculiarities. There are spots, whiskers, down, etc., each hair of which is itself a universe of living cells.

The hair system automatically reacts to its environment in a simple way, growing when the root-cells are nourished, falling out when diseased, varying with temperature, etc., all inevitable results of natural laws applied to the cell-system.

A more complicated cell-system is the digestive apparatus of the leopard. This, too, was evolved according to natural laws so as to give a system whose reactions to environment were better and better adapted to maintain the existence of the leopard family. The secretions and juices of the stomach and other digestive organs and all of their operations are automatic, mechanical reactions to environment, the inevitable result of the pressure and chemical actions of food, and other environmental conditions, on the existing cell-organization.

Furthermore, the entire digestive organization and its reactions, complicated as they are, are entirely the result of evolutionary processes.

A further step in complication of cell-organization is the system of brain-cells which determines the "instincts" of the leopard. When the stomach-nerves have the environment of satiation, warmth, etc., and when the general environment gives the complex condition "contentment" the leopard gracefully rolls over and lazily curls his paws in a well-known manner. There seems no reason for assigning any other cause for these actions than automatic cell-reactions to environments, of the same kind as in the hair system or digestive system, but of greater complexity. Similar remarks apply to all other actions commonly called "instinct."

A chicken hatched in an incubator, and raised by itself in a brooder and never seeing another chicken, so that it has no means whatever except "instinct" of conducting its life, will scratch, drink, set and mother a brood of new chicks just as its ancestors did.

Such considerations lead us to define an "instinct" as the brain-reaction which is the inevitable mechanical consequence of an environment on the evolved brain-cell organization. Each instinct is in process of definite evolutionary development just as is any of the other cell-organizations of an animal. Much of this is probably admitted for animals, and the extension here made is to many of the so-called mental processes of the human brain.

As we have defined it, an instinct is essentially an "inherited" mental process. In addition, as already remarked, the brain-cell organization is subject to change, resulting in "acquired" mental processes called "habits" which are discussed later.

We postulate that the brain-cells which carry instincts and habits and which are at the ends of the outgoing or

muscle-nerves, are an entirely distinct set from the consciousness-cells at the ends of the sense-nerves.

Men who hunt or fish for pleasure retain instincts evolved during the prehistoric period when such instincts preserved existence. Many instincts (as for instance that desire to subject the ear-drum and connected nerve-system to certain complex air-waves, called "love of music") are probably neutral so far as preservation of existence is concerned.

All instincts are transmitted according to the laws of heredity studied by Mendel and his successors, in a perfectly mechanical manner. That cell-organization of parents which produces a given instinctive action when aroused by consciousness due to a given environment, is transmitted according to the same mechanism as governs the transmission of the characteristics of sweet peas or fowls.

A "prodigy" performs certain acts, such as arithmetical feats, with extraordinary facility without instruction. The fact that the process is entirely automatic and instinctive indicates that it has some sort of mechanical nature. So far as I know there has not been sufficient psychological study of the matter to even indicate the nature of the mechanism. It is probably some sort of an instinct as above defined.

Reflex Actions.—This term is used by different psychologists to cover quite different regions. There are often included various effects of environment which are relayed by brain-cells. These are covered by the "instincts" just discussed since relaying by a central brain is the distinguishing characteristic.

Blushing and certain sexual effects are often called "reflex actions." However, they may be caused by stored memories of environments, as well as by original environ-

ments, which means that a central brain participates. Hence they are properly "instincts" as we have defined them.

We have already demonstrated the mechanical nature of "instincts," and the same remarks apply to any instincts which may be termed reflexes.

There are also nerve-centers, "ganglions," and the like in various parts of the body which receive incoming nerve-pulses and deliver outgoing ones without transmission to a central brain. There are thereby produced beating of the heart, breathing, digestion and the like.

The term "reflex actions" is often limited to these cases. As the brain is the only organ which stores remembrances, effects such as these in which the brain does not participate, cannot be produced by memory. Such effects are obviously mechanical and they need no further discussion.

Habits.—The organization of brain-cells at the ends of the muscle-nerves, which carries our instincts, is not immutable, but varies from time to time. The reactions produced by the consciousness of a given environment depend upon the exact condition of the mechanism at the instant. There are well-known temporary changes produced by the toxic effect of tiredness or illness, the stimulation of joy and the like. There are also more or less permanent effects produced by education which are popularly called habits.

The brain-cells in question, when excited by a given consciousness, may from any temporary cause react in a certain way, resulting in a certain action often more or less circumstantial. The way is then paved for an easier performance of the action when the same consciousness arises a second time, and so on. Presently some sort of growth is established and a habit is formed. Then the cells at the brain-ends of the sense-nerves will as a result of a given consciousness and the impulse it causes on the cells at the ends of the muscle-nerves, finally produce a

definite muscular action called habit. There are a number of ways in which habits are formed.

Firstly, there is the training or education of a rudimentary instinct. The environment of a being may be such as either to wholly extinguish such a rudimentary instinct or else to develop it so as to result in the formation of a definite habit. Examples are various aptitudes for handling capenters' tools or machinists' tools or for playing certain musical instruments, the tracking or capturing of prey by certain breeds of dogs, and the living of a wild life by a domestic animal when occasion demands.

Secondly, there is formation of habit due to "imitation." As already explained, an instinct is initiated by the effect of a certain environment on the perceptive senses. An "imitation instinct" is initiated when the perceptive senses are impressed by the performance of a certain action by another being. For instance, the brain-cells of a parrot are so constituted that the impression produced by speech upon its hearing nerves initiates a rudimentary reproduction. Continual repetition gives facility and soon the parrot repeats a certain set phrase. Exactly similar considerations lead a human infant to imitate various acts of those around it, so that it learns to walk, talk and otherwise conduct itself.

Thirdly, there is formation of habit as a result of repetition of actions originally initiated by a consciousness which is due to a present environment as well as to remembrances which the environment has called up. The repetition of such actions educates the muscle-nerves in such a way that eventually but little memory effect is needed and the action is initiated almost wholly by environment. An example is the playing of the piano. The meaning of the notes on the staff, the appearance of the fingers when in the correct position, and other details are memorized. Then the effect on the eye nerves of a bar of music together with associated

remembrance of the instruction, cause the fingers to play the bar. The necessity for the joint action of both direct and memorized consciousness causes more or less hesitation at first. Presently the memory is not needed and the bar is played in an offhand manner, merely from the effect of the environment of the presence of written notes before the eyes. That is, the habit of playing by sight is acquired.

A fourth way in which habits are formed is by repetition of a cause which is accidental so far as the being is concerned. An example is the training of the young, or the training of an animal to do tricks. Through some device or other of the trainer, a given action of the subject is caused to occur in connection with a given environment. Thus, a dog without any reason so far as the dog is concerned, jumps when a hoop is presented by the trainer. Repetition devised by the trainer soon establishes the habit.

A juggler, by some trick of the muscles, executes a certain feat and after patient trial successively repeats it until a habit is established.

Important items in the establishment of habit are the juice-secretions or other physical effects on the whole organism which we call pleasure and pain. Certain environmental conditions stimulate some sorts of mechanical action, either with different individual characteristics or with excess and deficiency of a single sort of thing, and then there arise conditions popularly said to be pleasant or painful. For present purposes the only characteristic of this action which we need to consider is that pleasure serves to deepen the traces of any habit effects with which it is associated. There is some sort of a fixation effect on any habit impressions which have recently been made.

An example is the familiar experiment in animal psychology where a caged animal must perform a certain action, such as raising the latch of a trap-door, in order to obtain food. The general excitement produced by the unpleasant-

ness of hunger produces actions of all sorts and presently the trap-door is accidentally opened. There is a faint trace of the accidental action which is at once deepened by the ensuing pleasure and a habit is begun. The same thing occurs again with a slight bias toward the correct action. Soon a permanent habit is established. Similarly a child whose hand is in a hot place is impressed by the action of withdrawal, and soon establishes the habit which we term "dreading fire."

Mechanism of Instinct and Habit.—As remarked in the preceding descriptions of these actions, instinct and habit are properties of cells at the brain-ends of the muscle- or outgoing nerves. When these cells are acted upon by an impulse due to the condition of other cells at the ends of the perceptive or incoming nerves called "consciousness," arising directly or through memory, the muscles mechanically perform an instinctive act or act of habit.

Instinct, as a matter of definition, is inborn. A point also to be emphasized is that the nucleus of each habit is inborn also. The effect of education has already been considered, but it can only develop an inborn rudiment. The kind of action of a muscle of course depends on the condition of the mechanism which in turn depends upon the initial inheritance and the subsequent alteration by environmental conditions. We are so used to performing all of the actions of daily life that we may be inclined to think we do these things because we want to, but close analysis will show that we do them as a matter of habit. We are born with a few instincts, such as to cry and to suckle, and we learn by great labor to talk, walk, dress, use a knife and fork and the like. If occasion arises for performance of any unusual action, such as the tying of a complicated knot by a person not used to such matters, or even the use of the left hand, or the ring finger, for a purpose for which

it has not been trained, we make use of such habits as may have been acquired, and move the fingers in a clumsy way. No amount of will or so-called reasoning power will enable us to perform the action the first time. We perform it first as a matter of accident while thus groping around among the habits already acquired, and can only perfom it with facility after that education called practice.

These considerations seem to me to establish beyond question that instinct and habit are mechanical effects. The crude analogies of the player piano and the relay mechanism have already been mentioned. The exact action initiated by the consciousness arising from given environmental circumstances, whether due to instinct or habit, is the result of the evolved condition of the brain-cell system as already considered. The differences between the actions, habits and instincts of different human beings, or of human beings and animals, are of the same nature as the differences between their skins or skeletons or any other set of physical characteristics. As already remarked, the passage of excitation of some sort from cells at the ends of sense-nerves to cells at the ends of muscle-nerves we have called an "impulse," and this we will discuss in detail later.

It is to be noted that we postulated that memory and habit are wholly different things carried by different sets of cells connected respectively with the incoming or sense-nerves and the outgoing or muscle-nerves. We remember an environment due to reproduction on the sense-nerve cells of the effect of the original environment. We do not, however, remember how to walk or to button a coat, but have learned to do these things through the mechanism of an entirely different set of cells. Amnesia is loss of memory due to derangement of the corresponding cells and does not affect the habits. Paralysis is loss of power of the muscle-nerves and does not affect the memory. Frequent cases of amnesia are reported where a subject loses

power to recall stored remembrances due to a disconnection of some kind in the brain-channels. In such cases the habits are not affected and the subject can walk, talk and conduct his life. On the other hand, after some kinds of illness, a patient must learn to walk or to resume similar habits. It is considerations such as these that have led me to postulate that habit and memory are properties of entirely distinct cell-groups.

Most of the organs and cell-groups of the race have been evolved in identical form for both the male and the female sex. There are, however, certain organs and glands with sex distinction. The secretions from these may cause different actions of originally identical organs. It seems probable that the entire mental organization of brain and nerves, consciousness, memory- and habit-cells, is identical in both sexes. The secretions of those sex organs which are different give chemicophysical actions on the brain-cells which cause whatever differences there may be between the aptitudes, tastes, affections and natural instincts of males and females of equal rank in evolution and development.

VI. THOUGHT.

Association and Ideas.—The effect of association in bringing remembrances of past events into play has already been alluded to. We define an association as the action whereby the consciousness of a present environment recalls the stored memory record of a past consciousness so as to renew it. The memory of an event may remain for years as dormant as a phonograph record stored in a cabinet, but when the proper association brings it forward, it renews the original consciousness in a way more or less similar to that caused by a present environment perceived by the senses.

A consciousness due to a present environment recalls a past environment which is similar. A consciousness due

to such a recalled environment in turn recalls a past environment which is either similar or which was memorized at a time near to that of the recalled environment.

As an example, I have just looked at an electric light, and this recalled an incandescent gas light, which in turn recalled a gas plant in Philadelphia and a certain brick building in the plant.

We need spend no time in discussing the wide range of things covered by the term "similar" which are recalled by memory association. There are, of course, a thousand things similar in various ways to a given environment and any of them may be recalled. In many cases there is recalled a composite group called an "idea," which combines many similar elements from past experience.

For instance, I have recalled the sounds making up the word "statue." This in turn recalls the definition of the word, with many shades of meaning, some particular statues, the use of the similar word "stature" in speaking of the shape of a man, and many other things comprised by the idea of statue.

Each time an idea or some element of one is recalled, something is added to it, either in the way of enrichment or intensification. All of the related elements comprising a composite idea are stored together in some way, just as related items are recorded on a single card in a card-index file or as related papers are kept in a pigeonhole. The association tie recalling the idea rotates this pigeonhole to the front, some or all of the elements of the idea come to our consciousness and a new element, due to the present environment which caused the recall, is added to the things already in the pigeonhole. The pigeonhole is then pushed into the background and may not come to the front for years.

When an idea is recalled, there may also be recalled things not a part of the idea, but which were memorized

at the same time as were some of the components of the idea. Thus the idea of statue recalls to me certain public gardens surrounding a certain statue and the pleasure boats in the garden. Each memorized thing is thus associated with a multitude of other things by some sort of ties, both of similarity and of contemporaneity. A type-setting machine forms a very crude analogy. A multitude of matrices are stored away, and one comes to the front when the proper mechanism operates to call it out. Here there is, however, nothing analogous to the addition of a new element to the thing recalled. Association thus fastens together all of the vast number of ideas or remembrances of past events with a multitude of ties, each idea linked to a thousand others by some sort of similarity, giving a network complex beyond understanding.

As each idea is remembered, it actuates some one of the thousands of links connected to associated ideas and another idea is remembered. The present environment has some influence or other in determining which other idea is brought forth. The fact to be emphasized is that successive ideas do not come forth arbitrarily but always due to some sort of mechanical connection. The association ties are real links of some mechanical sort acting just as definitely to bring forward the associated ideas as do the compressed-air connecting pipes of the type-setting machine. In testing subjects by Binet-Simon methods, one almost sees the mechanical nature of association links.

Our various ideas are more or less deeply "impressed" on our memories. This is, of course, a purely mechanical action whereby the chemicophysical effect which produces the memory record takes place in a more vigorous way so that association ties bring it to mind more easily.

Ideas are of very diverse kinds. Some are results of manifestations of natural phenomena, such as gravity. We see falling rocks or fall ourselves in childhood. We are

later told of the "law of gravity" as being a reason why things fall toward the earth instead of away from it. So each successive item is added, and by the wonderful power of association, each attaches itself to the nucleus of the idea already existing, so that it forms part of the resultant consciousness arising from the recall of the idea at any future time.

Some ideas are said to be "abstract," such as "justice" or "mercy." However, there is always a large concrete element and "justice" brings consciousness of law-courts and arrest of burglars and some specific instance of fair treatment. Each element of an idea has been formed by a consciousness arising from sense-perception of a concrete environment and every idea consists of a complicated résumé of such perceptions. Of course, an essential part of an idea is its name, and the sounds concerned with the spoken word and the image of the written word, form part of the memory record.

One idea which we have acquired partly from instruction during childhood and partly from actual experience, is the idea of "self." It is often stated that one of the important characteristics of the human mind is its power to have consciousness of itself. However, I do not see that this particular idea is more important or fundamental than a thousand others.

It was comparatively easy to formulate a conception of a mechanical consciousness, since we only need to realize, as already pointed out, that some sort of physicochemical reaction must be caused by the sense-nerve pulse, in the brain-cells at the end of the sense-nerves. It was also easy to make the next step, which is that this reaction at the same time causes a brain-cell formation or arrangement which persists as a memory record. It is, however, much more difficult to formulate the method whereby successive additions to this record are made, of things which cause

a similar consciousness and so are associated together, so as to form the complex cell-organization or arrangement comprising an idea. As already noted, when certain associations recall the idea, there is renewed a chemicophysical action on the cells at the end of the sense-nerves which gives a résumé of the consciousness or original effect of the number of environments which comprise the idea. Thus an idea is a perfectly definite mechanical thing although we are not able to specify the precise kind of cell-arrangement or mechanism which comprises it. I do not believe, however, that the matter is as vague as the conception in the mind of the average psychologist, of the mechanism of our often-referred-to high-speed newspaper press.

It seems to me that the essential difference between the brain of man and brute is the possession of the group of cells which stores remembrances and ideas and recalls them by association. Some of the higher animals might, however, possess the rudiments of such a cell-group. The production of consciousness by environment, the resulting impulse which excites cells carrying instincts and habits, and the consequent muscular actions, seem identical in man and the higher animals. The animal, however, acts only from a consciousness produced by the present environment without influence of stored memories of past environment. As already remarked, we distinguish instinct and habit from memory so that the possession of the latter faculties by animals does not imply the possession of the memory-mechanism. Suppose that a dog has been taught to do a number of tricks, each having a distinct commanding sentence such as "Jump over the chair," "Fetch that stick," "Say your prayers." Suppose, however, that the dog were taught to wait to begin the execution of the trick until the executive command "Commence" were given. I do not believe it would be possible to teach the dog to wait for a period between the commanding sentence and the word

"Commence," if during that time something were done to attract its attention. If the word "Commence" were given immediately after the commanding sentence the dog would, of course, do the proper trick. In this case, the consciousness of the combined commanding sentence and the word "Commence" would initiate the acquired habit as already explained. This consciousness would remain in force until its effect had been accomplished. The attracting of the dog's attention to another thing between the commanding sentence and the word "Commence" would produce a new consciousness. The consciousness of the commanding sentence would then have to be stored or memorized and later recalled by association when the word "Commence" was given. So far as I know no dog or other animal can do this, and this is my reason for believing that animals have no memory. It is probably habit and not a memory rudiment which makes a dog cringe at the sight of its whip.

Thinking.—The train of consciousness effects due to the combination of perceptions of present environments and the successive remembrances of associated ideas brougth to mind by the present environments and by each other, we call "thinking."

Each combination affects our consciousness just as does any new environment and makes a new memory record, so that we remember what we think. If the flow of blood or brain-fluid or whatever lubricates and activates the association processes, is in good working order, and if present environments are not impressive and distracting, we are said to be in a concentrated thought. Then past environments are remembered, each bringing in some other by association, and a net consciousness is arrived at, called a "conclusion" or a "decision." We therefore define a conclusion as the composite consciousness which is the epitome

or summation of a train of successive ideas or associated remembrances combined with some present environment which initiated the association train. It is the net result of the entire combination of environments associated with a given thing, which we call experience. In fact, a conclusion not only represents one's own experience but often the entire experience of all previous human existence. Suppose, for instance, I am designing a machine and must select the size of a minor shaft which need not be found by detailed computation. I have learned "Machine Design" and am familiar with machines constructed by previous designers. I thus have a group of remembrances which represents more or less imperfectly all human experience. A certain amount of this is brought forth by my powers of association, when confronted with the environment of the missing shaft size in the design of the machine I am working on. I thus reach a composite consciousness of a shaft size which my experience has encountered under associated circumstances, and I say that I have "thought out" a shaft size which "looks right."

If I have a brain-mechanism whose association ties for this sort of thing operate well, I reach a good conclusion. In any event, the conclusion reached is purely a matter of the remembrance records stored in my brain, the power of my brain-mechanism to associate the sort of thing in question and the present external environment. There is no reason to seek anything else but a mechanical combination of these effects. True, we have reached a stage of mechanical complexity which we cannot yet grasp, but this is not a reason for introduction of non-mechanical effects. We do not grasp the mechanism whereby a dazzling flower is produced from the black earth and the sunshine and rain, yet we do not doubt the mechanical nature of the entire growth.

Those kinds of environment perceived by the conscious-

ness of an individual, those kinds of remembrances which are stored, the way these are associated with each other to form composite ideas, the way they are recalled by association, and similar circumstances, are dependent only upon the physical character of the brain-cell organization, as evolved through countless generations. The habit- and instinct-cells are similarly evolved, as already discussed. There is thereby determined completely the way the individual thinks in any environment just as definitely as the evolution of the digestive organs determines the reaction to food, or as the evolution of any other part of the body adjusts its reactions.

The Subconscious Mind.—We have concluded that successive remembrances brought to the attention of our consciousness by association, each have, to a large extent, the same status as a consciousness produced by a sense-perception of an environment, and are thus again stored as memory records. In some cases the old record is more deeply impressed. We thus remember when we remember anything. It may happen that such remembrances of a train of associated remembrances are not all deeply impressed except for the final conclusion. Hence we may forget the steps of the train and so far as a permanent record is concerned, only have cognizance of the conclusion. Such an action is said to be that of the "subconscious mind." The belief is common that this subconscious mind operates automatically. However, the theory we here seek to establish is that all of our thinking is done in some such way and that the only difference between subconscious thought and ordinary thought is in the depth of the memory-impression of the successive remembrances brought into action by association. Our theory of the automatic nature of all thought due to successive association, is therefore quite similar to the usual idea of subconscious thought.

The psychoanalysis of Freud has shown that in a great many cases a remembrance of a particular environment has formed the genesis of an idea which has associated itself with such other things as to give it great importance, although the original thing itself is forgotten or recalled with difficulty.

Mechanism of Thought.—Of course, the association ties we have discussed are not steel links which inevitably bring forward a definite remembrance whenever the corresponding key is struck. The extraordinarily complex mechanism which calls forth remembrances, is the cell-system carrying consciousness, in its instantaneous condition due to a combination of the effects both of our environment, as perceived by all of our senses, and of remembrances next previously brought forward. Then there is the physical condition of the various cells involved, and the effect of the toxins, juices, narcotics, stimulants and activators due to tiredness, pleasure, pain, ill health, emotion, vigor and many other similar items. In addition the condition of the cell-system where the memory records are stored further complicates the situation. Different kinds of remembrances are recalled with different amounts of facility by different brains. The association mechanism of my own brain handles mechanical ideas with facility and ideas regarding female millinery with difficulty, while my wife's brain is the reverse. All of the discussion previously given regarding evolution and heredity of the cell-system controlling habit and instinct, also applies to the quite distinct cell-system governing memory association. In this way individuals and races have been evolved which think well in certain directions and the memory and association system itself has been formed. As already mentioned, I do not

believe that animals have the power of recalling past environment by memory. Hence they cannot think.

The depth of the memory-impressions regarding a certain subject, and its importance to us, may cause concentration of thought on this subject, and discourage the presence of varied miscellaneous associations which local environment and the like tend to bring forth.

All of these effects have an influence on the train of thoughts teeming through our brain at any instant. The seething consciousness-cells, alive to the effects of all of the surrounding environment on all of our senses, with each such effect crowding along its train of associations, and each of these carrying a new train, give a thought-mechanism of incomprehensible complexity. Yet there is no reason for supposing that there is any effect which is not due to the matter in the brain-cell organization, its past history as manifested by the state to which it has been brought, and the present surroundings both of the cells in the brain and of the being in its environment, all interacting in a perfectly mechanical way.

The normal brain-cycle involves interaction of many individual parts, senses, nerves and cells. Change in the action of any of the elements gives a variation of the cycle. Thus we may have tiredness, sleep, dreams, automatic writing, trance speaking, delirium, drunkenness, insanity, paralysis, amnesia, hypnosis, idiocy, infancy, age, second childhood, and so on. All of these things have a purely mechanical basis. Sleep may be merely the shutting-off of the pulses from the sense-nerves, so that there can be no consciousness of present environment, but only circumstantial recall of remembrances. Analysis of the mechanism of the mental effects mentioned must be postponed for lack of knowledge. Their study from the point of view of the present paper will give more detailed knowledge of the brain mechanism.

VII. REASON AND IMPULSE.

Reasoning.—There are two forms in which the old conceptions of "reasoning" may be expounded, the definite one of "formal logic" and the rather vague popular one. We will endeavor to show that neither conception gives such an adequate explanation of the action of the brain as is igven above by our theory of recall of remembrances by association.

Formal logic asserts that we think by "deductive reasoning," in syllogisms, with major and minor premises and conclusions. For instance, take the major premise: "All agencies which produce mechanical energy when no mechanical or heat energy is supplied, produce this energy by transformation of chemical energy which has been supplied to them." A minor premise is: "Human bodies are agencies which produce mechanical energy when no mechanical or heat energy is supplied." The conclusion is: "Human bodies produce mechanical energy by means of chemical energy which has been supplied to them." This is a case of the simplest type of syllogism and is of the kind classified by ancient logicians as being in the figure "Barbara."

I have arranged a rather complicated case, so that a little study is required to draw the conclusion, with the idea that the reader's own effort to verify the conclusion will illustrate the mental processes involved. It seems to me that we draw the conclusion solely by means of associations and past remembrances which the premises recall. We have had experience in past cases where a characteristic common to all members of a class is possessed by all members of any group in this class. Any syllogism in Barbara implied or expressed recalls such associations, and they in combination with the particular premises give that resultant idea called the conclusion.

Following are two more syllogisms both classified as being in the mood "AEE" and in the first and second figures respectively. "All M is P. No S is M. Therefore, no S is P." "All P is M. No S is M. Therefore, no S is P." One of the conclusions is valid and one is invalid. I believe the average reader will make some mental effort in determining which is valid and which invalid. In doing this it seems to me he draws only on his past experience, and reaches the conclusion solely by associations with past remembrances of regions which include or exclude each other. The first syllogism above is the invalid one and the second is valid in the mood called "Camestres."

Another example is: "All birds are vertebrates. Some winged animals are not vertebrates." Can the reader reason directly that a valid conclusion is "Some winged animals are not birds"? This is a valid syllogism in the mood called "Baroko." The theory we have advanced implies that there is no such thing as "deductive reasoning," but that all conclusions are reached in the way called "induction." We make comparison with things of past experience which our association ties bring forth as being similar.

Hence there are two ways in which we certainly do not reach conclusions. In the first place we do not use the rules of "formal logic." There was a time when the principles of logic were considered a necessary part of a good education, but this is no longer the case. A person who has never heard of logic can reason perfectly well. Hence it seems evident that the logicians' analysis of reasoning is not the correct one. In the second place, the conclusion of a syllogism is not directly obvious to a reasoning being. I believe this will be admitted by any one not familiar with formal logic who will work on the syllogisms given above.

It is "popularly" supposed that we reason by an infallible process which gives us the absolute truth concerning given

circumstances, and which is beyond any material explanation. I see no basis for such a supposition, however.

One point to be made is that reasoning produces nothing new. A conclusion states nothing which is not implied by the premises. A train of reasoning only brings to our consciousness either an independently existing fact, or else something which past associations indicate to be such a fact. A discovery of a scientist, or an invention of an engineer, are in the ultimate analysis nothing but consequences of associations recalled by brains with extraordinary powers of memory and associative ability. As the association ties are calling each other out in a manner depending upon the conditions of the instant, some circumstantial combination may occur. In a mind rich with associations in a given field, this leads to some more definite train and so a novel idea is originated or an invention made or a natural law discovered. Such things really happen with great rarity and most of our thoughts are rearrangements of familiar things.

Each generation learns the things left by the previous generation and adds a little from such novel associations. Wonderful as our progress it, it is really very slow. Eons ago we gesticulated and grunted. After some ages evolution produced a few brains which associated certain sounds with certain environments, and so speech arose and was taught to others. Next written records were made. Some brain in each of a number of races, by some circumstantial combination of associations made a contribution to these advances. Thus arose different kinds of written records, hieroglyphics, ideographs and phonetic writing. There was no definite system of reasoning whereby the successive advances were worked out. Similarly the different arithmetical systems were made by successive contributions of individual brains. In modern times we are building sys-

tems of physical science, engineering and the like in the same way.

Beliefs and Truths.—When an environment of any kind presents itself to our consciousness, whether the germ of a new idea or something which can be attached by association to a previous idea, it forms some material thing which becomes an essential part of our being. An idea is therefore some sort of cell-formation or arrangement which is of the same nature as a finger nail or a digestive gland. For instance, we have the idea that a body falls toward the earth. Anything which recalls the idea of falling involves consciousness of falling toward the earth. There is a clash or inconsistency of some kind if some one remarks that he saw a table rise from the floor. We say that this is contrary to our belief. Our ideas thus constitute a code of beliefs or things we regard as truths. The important point which must be made is that a belief is not necessarily in agreement with natural laws, that is, not necessarily true, but only represents the net result of things presented to our consciousness in the matter.

There is, however, a system which by definition is uniformly true, and this is the code of natural laws. Philosophers and psychologists speak of the "uniformity of nature," but I do not believe they can have such a keen appreciation of the situation as an engineer or other worker in natural science. A novel type of machine or a new bridge construction or a chemical manufacture on a large scale, operates successfully as the result of the combination in the design, of certain natural laws which were ascertained with small models in a laboratory. We must admit that there exists a code of such natural laws which our finite brains can make use of and by virtue of which we can construct mechanisms, plant seeds and conduct our lives, with cer-

tainty that the final result will depend exactly upon the way the circumstances are controlled.

Our beliefs are true only in so far as they are in harmony with this code of natural laws. Our only means for ascertainment of the validity of a belief is comparison with natural law in so far as we are able.

The evolution of a race depends wholly upon the ability of the brains of its members to conduct themselves so as to exist in the natural world. Hence ability to come to more or less perfect agreement with natural law has been accomplished.

However, we may hold many beliefs which are false, either because we have not compared them with natural laws or because we have made inaccurate comparisons. We have already noted how circumstantial associations of a fertile brain occasionally make a novel combination resulting in an invention or discovery. On the other hand, such a cause can equally well originate a fallacy which, however, has the appearance of truth. By transmission from such a source or by some incorrect combination in our own minds, we obtain such false beliefs. The history of Oriental religions and the history of the beginnings of science show us that men can hold a belief with the utmost confidence which is wholly false. We are loath, however, to admit the possibility that any of our own personal beliefs may be in this class. Yet this is certainly true. "Faith" is the term we apply to our confidence in our beliefs, but it is an uncertain foundation. A certain belief may assist in the evolution of a race and yet be false. Many of the beliefs of ancient and modern religions are false and yet it is conceivable that some may have been of advantage.

The only test, then, of the truth of a belief is comparison with natural law. The mere speculations of philosophers have never led to stable results. Many of the beliefs of scientists, engineers, farmers and others who work with

the laws of nature have, however, been proven true by the success of results of applications of these beliefs. I have certain beliefs in science and engineering and have designed novel machinery based on these beliefs, which has operated successfully. I have by associations of various kinds extended such beliefs to the subject-matter of this article. The extent of the agreement of other observers of natural laws with these beliefs and results of future progress will determine to what extent these beliefs are correct.

We acquire many beliefs from simple statements of others. If the idea involved does not by association recall a similiar idea we have a new belief. If it does recall a similar idea with an opposite conclusion and if we can associate the particular situation with previous general ideas of the impossibility of opposite conclusions, we accept the new belief and modify our idea in the matter, or else reject it, according to previous associations. Thus teachers, exhorters, politicians, preachers, expounders, parents and friends take part together with our own experiences and interpretations of our environments and perceptions of natural phenomena, in giving us a set of ideas and beliefs which are embodied in some sort of cell-arrangement as definite and concrete as the pores in our skin or the hairs of our head.

As an example of the way we reason consider the matter of faith in some religious custom.

In order to avoid the risk of poisoning by a wife, certain Hindus somehow started the custom which soon grew to be an important matter of faith, of burning of widows by suttee. We know that even though many people for centuries had faith that this was a matter of absolute necessity, that it actually was nonsensical. Hence the faith or firm belief of a human being that a certain thing must be so because they feel that it is so, is no reason whatever for supposing that the thing really is so. However, many

people do not associate this general situation with things they themselves have faith in. Others do make such an association and consequently do not accept things on faith.

Impulse and Will.—We have already formulated the hypothesis that cells at the end of sense-nerves carrying a resultant consciousness of present environment through sense-perception and of past environments through recall of remembrances by association, become by virtue of this resultant consciousness so charged or activated that they excite a corresponding combination from an adjacent group of cells at the ends of muscle-nerves carrying instincts and habits, and so initiate an action. This excitation or "impulse" to act corresponds to the "will" of psychology. Our theory of the mechanical brain of course corresponds to the mechanistic side of the old debate concerning free will, and this paper attempts to outline the mechanism involved.

It is not to be supposed that this impule to act is as definite a thing as, for instance, the rotation of a toothed wheel when an intermeshing wheel is rotated. The entire history of the ancestors of the individual as affecting the inherited condition of his brain and the entire history of his environments as affecting the brain's present condition, all have their influence. There are no factors which do not exist either in the brain-cell organization or in those external things to which it has reacted according to the laws of nature. It would indeed be strange if there were any accident or caprice in a universe which we find to be so wonderfully ordered, from the smallest details shown by the microscope, to the mighty things shown by the telescope.

Good illustrations of the dependence we place upon such principles, though we do not realize it, are the teachings and preachings to inculcate ethics, morals and religion by parents, teachers and preachers. By adding to or creating in the brain of the subject some ideas as to the thing

we believe to be "right" under given circumstances, we expect to influence the subject in a given future environment. Our exhortation implies a number of things. In the first place, we expect to create an idea in the mind of the subject which will persist until some future time. Obviously we expect that in the meantime it must exist in some way or other. There can be no magician's act which makes a thing vanish and later reappear from nowhere. Now we know that some kinds of environment, such as warmth, have a definite influence on the cells in the interior of our bodies. We know as well that our words have a definite mechanical effect on the ears of a hearer, and start an actual pulse along the nerves to the brain. But this pulse does not trail off into nothing when it reaches the brain. It seems to me that the hypothesis most readily agreeing with other experiences which we have with natural phenomena, and therefore the thing to be believed, is, as already discussed, that the nerve-pulse finally results in a definite brain-cell formation or arrangement recording the idea in a concrete way. The record is later recalled so as to give a simulation of the effect produced by the nerve-pulses from the sound-waves of our original exhortation.

In the second place, our exhortation implies that we expect that upon proper occasion, the subject will act in accordance therewith. We therefore expect that that condition of the subject's brain-cells which we have created, and not some caprice of the subject, will cause action when the future environment arises.

The extent of the association which a given environment arouses in an individual determines the kind of consciousness which creates the impulse. If there are usually recalled a very limited or superficial set of remembrances, the individual is wilful or emotional. If there are usually recalled deeper and more varied remembrances, the emotions are controlled by reason. However, in all individuals

there are many impulses which are produced by a consciousness only due to present environment without remembrances. Thus we jump when we hear a loud noise and withdraw the hand from a hot place. Such actions we term "instinctive" or "automatic." They differ from other actions only in the type of consciousness which impels them. These are the only kind of actions possible with animals according to our postulate that they have no memory and can only have consciousness of a present environment.

A very crude illustration of the way the impulse-mechanism might operate is as follows. The cells which carry consciousness of sense-perception may lie along a folded surface in the brain on the other side of which lie the cells at the ends of muscle-nerves. A given consciousness consists of expansion by flow of blood or some other form of excitation of a certain combination of the sense-nerve cells. Impulse is the pressure or other effect of this excitation, across the surface, to the muscle-nerve cells, which excites or energizes a corresponding combination of them. This starts the pulse along the muscle-nerves which causes an action.

Thus each group of the untold number of possible combinations of cell-reaction due to sense-nerve and memory effect gives an impulse to that group of muscle-nerve ends which corresponds or matches with it. The correspondence determines that instinct or habit which is called forth in the given individual as a result of given environmental conditions.

VIII. DIAGRAM OF THE MECHANISM OF THE HUMAN BRAIN.

The accompanying figure and explanation gives a résumé of the way my brain associates its actions with the gross mechanisms to which I am accustomed. The application of my own theories to this paper means, of course, that I view this matter from a mechanical standpoint. Time

and study will determine if comparisons made from other standpoints are less accurate.

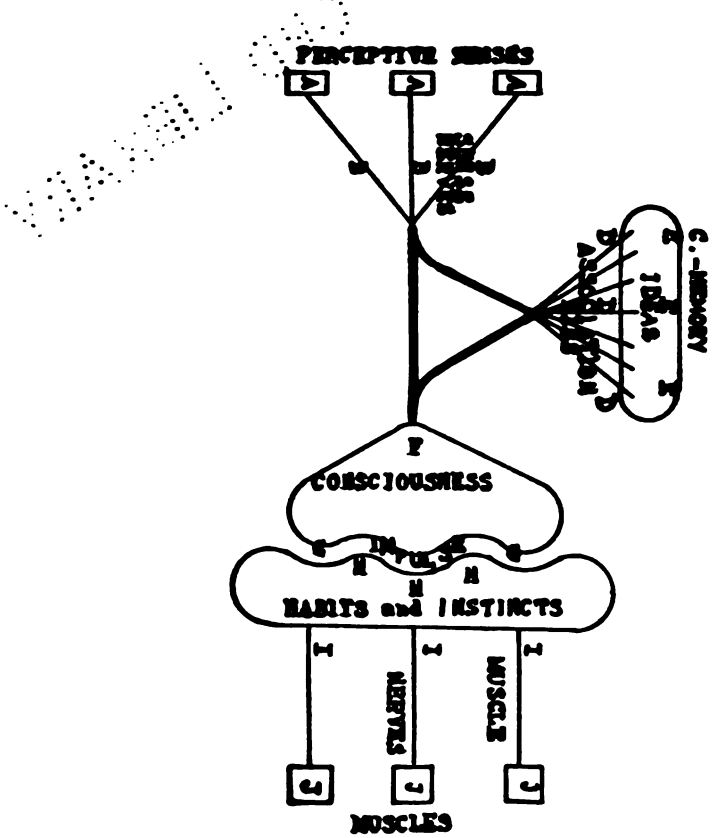


DIAGRAM OF THE MECHANISM OF THE HUMAN BRAIN.

AAA—*Perceptive Senses*: Sight, hearing, etc. Mechanisms affected by various kinds of external environments, forming the means by which the influences of these environments start toward our brain.

BBB—*Sense or Afferent Nerves*: Channels whereby incoming pulses initiated by effects of environment upon the senses are transmitted to the brain.

C—*Memory*: The stored-up record produced by the sense-nerve pulse at the same time it is producing consciousness. When any one of the ideas stored by the memory is recalled by association, it simulates or reproduces the effect of the original consciousness. Possibly the possession of this memory organ is the distinction between man and brute. The memory record exists as a concrete material thing, being some sort of

cell-arrangement or growth, of such kind as will renew the effect of the nerve-pulse which created it.

DDD—*Association Ties*: The means whereby a present consciousness recalls the stored memory record of a past consciousness so as to renew it, due to similarity or contemporaneity. A new element due to the present environment is thereby added to the record.

EEE—*Ideas*: The composite record of similar elements from past experience successively added by association. All or part of an idea is recalled to form a resultant consciousness by an association tie connecting it with a similar present environment. The recall of ideas by associations arising from the consciousness which each one successively produces is called "thinking."

F—*Consciousness*: A physicochemical reaction on brain-cells at the ends of sense-nerves, caused by the pulses from the senses, and constituting the entire result of the sense-perception of an environment. It may arise either directly from a pulse caused by a present environment or from records of such pulses from a past environment stored by the memory or from a resultant of both.

G—*Impulse*: That reaction of the cells at the ends of the sense-nerves, due to a resultant consciousness both of present environments and past ones from recall of remembrances, whereby a certain combination of cells becomes so charged that it excites the corresponding combination from an adjacent group of cells, at the ends of muscle-nerves, carrying instincts and habits.

HHH—*Instincts and Habits*: Reactions of cells at the brain-ends of the out going or muscle-nerves due to excitation by an impulse from cells carrying consciousness. A certain one of the untold number of possible combinations of the instinct- or habit-cells, corresponding to the particular consciousness-cell combination, thereby initiates a muscle-nerve pulse. Instincts are reaction combinations which are inborn. Habits are combinations with an inborn nucleus developed by education.

III—*Muscle or Efferent Nerves*: Channels whereby outgoing pulses initiated by habit- and instinct-cells in the brain are transmitted to various muscles.

JJJ—*Muscles*: Mechanisms of various kinds which perfom all sorts of actions when excited by pulses from the muscle- or efferent nerves.

SANFORD A. MOSS.

LYNN, MASS.

A DEFECT IN CURRENT POLITICAL PHILOSOPHY.

THE fact that political philosophy has its roots in the past carries certain consequences. In the first place, it follows that the present situation cannot be fully understood without reference to the premodern State: but, on the other hand, the nature of the premodern State must not be taken as fixing the character of the modern State. A consideration of the premodern State as it appeared to the great writers on political theory may therefore be of use not only in tracing origins, but also in bringing out what is peculiar to modern States. The facts that (1) the interdependence of modern States within the modern State system affects the character of each State, and that (2) the modern State excludes religious and other activities, render this contrast necessary.*

There have been, obviously, many different kinds of State, however we are to classify them; and the abrupt division into modern and premodern must be understood to be in some sense an arbitrary one. This being granted, we shall speak first of the segregation or isolation, and next of the absolutism or inclusiveness, of premodern States; especially in so far as those features were recognized and supported by political theory.

The Greek City-State was not in fact all that Plato and

* [A short description of these characteristics of modern States will be found in Mr. Delisle Burns's book on *The Morality of Nations*.—ED.]

Aristotle imagined that it was or hoped that it might be.[1] In speaking of their conceptions, therefore, we shall have to make some reference to the facts that do not quite support them. But, for our present purpose, their conceptions are even more important than the facts; since their political theory has so largely influenced even our modern practice.

The three expressions of Plato's idea of the πόλις, in the *Republic*, the *Statesman* (with some part of the *Gorgias*) and the *Laws*, contain slight differences. It is clear, however, with regard to the leading idea in every case, that the πόλις is to be as far as possible self-sufficing: the difference in the three great conceptions of the πόλις is due only to the lessening importance in the later works of complete isolation. The classes in the *Republic* are intended to make the State self-sufficing.[2] Let us suppose, then, that all its ideas, all its energies, and all its supplies come to the community from its own citizens or subjects. There is, however, a warrior class among the citizens, for the Guardians are not simply administrators. But there must be, then, some human beings outside the πόλις. It is not generally noticed that Plato does not even hint at who they are, how they may be conceived to be organized, or what they may be supposed to be doing. They are merely "outsiders"; and the purpose of one class or section of a class in the πόλις as it ought to be, is to keep them off. And yet, even on the assumption that the State has nothing to gain by contact with them, their activities must surely make some difference to the structure or actions of even the ideal πόλις. This is simply omitted.

[1] The glaring omissions of Plato and Aristotle are noted in Newman's Introduction to Aristotle's *Politics*. There was interdependence in Hellas (games, music, drama, philosophy, "Homer," etc.) and there was even the beginning of interstate structure.

[2] *Rep.*, 374a: τί δέ; ἦ δ'ὅς. αὐτοὶ οὐχ ἱκανοί; And Socrates answers that we want all the "arts" in our city.

In the *Statesman* the warriors still have a place;[3] but apparently there *was* a time when there was no need of them, according to the myth of the "backward" life.[4] Probably, if there was a πόλις in existence then, its features would be the reverse of the essential features of the πόλις of this world. But for practical purposes, again, the State seems to need no goods or ideas from the outer world.

In the *Laws* the utility of some communications outside the frontiers of the πόλις is grudgingly admitted,[5] but only under strict surveillance. Thus in his old age Plato seems to have acknowledged that Athens owed much to non-Athenians: or perhaps he felt that men were too weak to be inhabitants of his Republic.

The same fundamental attitude is to be found in Aristotle, in spite of the fact that he had studied many States. It is astonishing that he did not see the importance of the connections between States. But he, too, abruptly announces that it is the essence of the πόλις to be αὐτάρκης,[6] and that, he says, "must be the State which is all-producing, for to have all things and to want nothing is self-sufficiency."[7] Aristotle probably saw that the actual πόλις of his day was partly isolated and partly dependent upon foreigners: and he quite seriously maintains that in so far as it aimed at τὸ εὖ ζῆν it was isolated or segregate.[8] But in practice, the State not being altogether isolated, some reference had to be made to those who did not belong to *the* πόλις or who might belong to other πόλεις. We arrive, then, at Aristotle's view of foreign interests and foreign policy. It is childish. It reduces itself to the idea that, negatively, the

[3] *Politicus*, 309.

[4] *Pol.*, 270 et seq.

[5] *Laws*, 950a, 951a.

[6] *Pol.*, 1252b.

[7] *Pol.*, 1326b, 27: τοιαύτην δ' ἀναγκαῖον εἶναι τὴν παντοφόρον· τὸ γὰρ πάντα ὑπάρχειν καὶ δεῖσθαι μηδενὸς αὐταρκες.

[8] *Pol.*, 1252b et seq.

government ought not to rely on foreign aid,[9] and that, positively, the legislator should have an eye to neighbors.[10] Presumably he may gain something from them; but his essential attitude is thus expressed: "A πόλις must have a military force serviceable against her neighbors and not merely useful at home. . . . A πόλις should be formidable to enemies."[11] Conquest is not to be the purpose of the State; but one of the reasons given is striking—it is because the State "happy in isolation" is the ideal,[12] and this in defiance of the fact that Greek States differed from barbarian precisely in their interstate structure and that Athens in particular owed her art and her science to foreign contact.

Even such a summary is enough to show how utterly inapplicable to the modern State system the political observations and ideals of Plato and Aristotle are. This does not involve any lack of appreciation for the exactness and brilliance of their dissection of society, so far as it went; but their influence has been so great that later writers have not been able to see how impossible it is to accept their views even of the *internal* structure of the State as applicable to a situation in which the *external* structure has so modified the whole issue. Even if the Greek πόλις was comparatively isolated, the modern State certainly is not.

When we pass to the Roman theorists, the same limited point of view seems to be prominent; for although nearly all late Republican and early Imperial history is a history of foreign influences, the thinkers still concentrate on the

[9] *Pol.*, 1294b.

[10] *Pol.*, 1325a: *καὶ τοῦτο τῆς νομοθετικῆς ἐστὶν ἰδεῖν, ἐάν τινες ὑπάρχωσι γειτνιῶντες, πότα πρὸς ποίους ἀσκητέον ἢ πῶς τοῖς καθήκουσι πρὸς ἑκάστους χρηστέον.*

[11] *Pol.*, 1265a, 19 et seq. An attack on Plato's *Laws* which accuses Plato of neglecting foreign relations, but implies that the essential foreign relation is that of war. Nevertheless, Aristotle here states the fundamental idea that you cannot consider the nature even of the ideal State without reference to those who do not belong to it.

[12] *Pol.*, 1325a, 1: *ἀλλὰ μὴν εἴη γ'ἂν καὶ καθ' ἑαυτὴν μία πόλις εὐδαίμων*: and for the ideal, 1325b, 31 et seq.

later excuse for it—"surplus population": it is due to the Machiavellian idea, based on a misreading of history, that one State is naturally hostile to another.

Hobbes asserts that the State is in "a state of nature" with respect to any other State; and this is defined as "the Warre of every man against every man." "In all times Kings and Persons of Soveraign authority, because of their independency, are in continuall jealousies and in the state and posture of gladiators. . . which is the posture of war."[22] As between States there is no "just and unjust." "Where no common power, no Law; where no Law, no injustice. Force and Fraud are in warre the two Cardinall virtues."[23] Hence foreign policy is to "weaken their neighbours,"[24] and the less contact with foreigners the citizens are allowed, the better it is for the State.[25] To continue with the English school, Locke is inclined to the same idea of opposition, but he makes two important changes, (1) in distinguishing the state of nature from the state of war,[26] and (2) in pointing out that progress depends on not leaving force in the hands of the interested parties in a dispute.[27]

In the later Renaissance Grotius recognized the interdependence of States,[28] but did not explain it. Nor did he base any argument upon it except the possibility of avoiding famine, revolution or foreign war. The author says that no one has dealt with the moral relationship between States, and he straightway begins to discuss war. Peace is given a vague blessing on the last page of his work: for opposition seemed to be the only obvious and

[22] *Leviathan*, II, 13.

[23] *Lev.*, I, 13.

[24] *Lev.*, II, 29; II, 17.

[25] *Lev.*, II, 29.

[26] *Civil Government*, II, iii, par. 19.

[27] *Civil Govt.*, II, par. 89. This has an immense possibility of development (cf. below Ch. X) but Locke does not seem to have seen how important it was.

[28] *De Jure Belli et Pacis*, Prol. 21: "Nulla est tam valida civitas quae non aliquanda aliorum extra se ope indigere possit." He implies much in the proposal to make or create a connection. The connection was there, actually influencing the nature of States.

essential contact. But a great step was made by the establishment of an idea of International Law and a morality on which that law depended. It is only astonishing that the theories of international law, perhaps because they were obstructed by the obsolete conception of sovereignty in such a man as Bodin, made so little difference to the conception of the nature of the State. The same difficulty obscures the attempts of the Abbé St. Pierre.

At a later date one would have imagined that the international culture of the eighteenth century would have made theorists elaborate an interstate structure, but even Rousseau leaves the subject with a sentence at the end of the *Contrat Social*:[29] and yet, if one omits the discussion of "external" relations the whole idea of the State is vitiated. Rousseau, however, saw that the relations between the States of Europe, based upon the similarity of their customs and laws, could be made political. He says in the "Extract" that, in fact, a permanent state of war degrades States. War is not an occasional accident, it is the fundamental institution in the relation of States,[30] but he conceives as possible a political unity—a Confederation of Europe.[31] In one fragment he says, "J'ai trouvé que les liaisons qui subsistent entre tous les puissances ne laisseront jamais à aucune d'elles le temps et la sûreté nécessaire pour refondre sa constitution."[32] But on the whole he does not give sufficient place to the influence of other States on the government of each. Kant, under the influence of Rousseau, elaborated a scheme of European confederation; but even he does not define the State by reference to its external contacts. He recognizes, however, that an interstate struc-

[29] "....il resterait à l'appuyer par ses relations externes."

[30] Vaughan, *The Political Writings of Rousseau*, I, 304, "L'état de guerre."

[31] Vaughan, *op. cit.*, I, 374. The whole magnificent "Extract" (Vaughan's *Rousseau*, I, 364) is in statement of political observation hardly to be surpassed, even though Rousseau does not allow enough, as it seems to me, to the beginnings of interstate political structure.

[32] *Ibid.*, p. 321.

ture would have some effect on the internal constitution of the several States.[33]

The Napoleonic wars which intervened, blocked the development of political thought, setting back political structure as war did at the Renaissance; so that Hegel in his *Philosophy of Mind* dismisses the whole of interstate relationship in one short paragraph (par. 547). He speaks as if there were nothing in it but what he calls "the game of war." In the *Philosophy of Right* a few meager sections are given to the relations between States.[34] The only foreign relationship discussed is war, which is blandly assumed to be "necessary" (par. 324) to preserve the individuality of the State, and even to be good. The principle, he says, is drawn from history. And what he meant by history may be perceived in his assertion (pars. 355-360) that "world development" shows the four great empires—the Oriental, Greek, Roman and German!

But Hegel lived in a primitive atmosphere. The great changes have occurred since his day. Let us, then, turn to the moderns. The English utilitarians seem to have imagined that the military organization of States could disappear without any growth of interstate structure: and their followers in practical politics stood for the idea of leaving "foreign" States alone. But this, though a step forward from contact which is mere opposition, would eventually lead back to the primitive segregation. And in any case the tendency to slur or omit the discussion of foreign relations was pernicious. Even Sidgwick, although he admits (in a note!) that foreign contacts affect domestic policy, devotes only five out of thirty-one chapters to interstate structure.[35] But the idealist school was much worse. Bluntschli divides the *Philosophy of the*

[33] *Perpetual Peace*, par. II, art. 2.

[34] "External Sovereignty" (pars. 324-329) and "International Law" (pars. 330-340).

[35] *El. Pol.* (ed. 1897), note p. 237.

State into (1) The State in General, (2) the State in Action, and (3) the State in Ideal. But he goes so far as to say that *the* State is "humanity organized, so as not to break up particular States," and that "only in the universal empire will the true human State be revealed" (English trans., p. 32). This implies that one can define the nature of a State without reference to its external relations. Again, he writes of sovereignty (Bk. VII) as though there were no such thing as the influence of foreign States on the administration of law and government.

Green is almost the only writer who develops at all the idea of the moral relationship between States. In his *Principles of Political Obligation* he deals with this issue.[36] He sees that the nature of the State is dependent on its relation with other States (par. 167 et seq.). "The source of war between States," he says, "lies in their incomplete fulfilment of their function, in the fact that there is some defect in the maintenance or reconciliation of rights among their subjects." Again, "War is a survival from a condition in which the State, in its full sense, was not" (par. 172). But even he gives comparatively little space to this, and the weight of his argument rests on the old discussion of the relations between citizens of one State.

Bosanquet, in his *Philosophical Theory of the State*, entirely omits the external relations of the State. The result is that his theory reads like a theory of the lungs with all reference to the air omitted. But it may be that he does not mean by the State what is ordinarily meant by it.[37]

[36] *Works*, Vol. III, reprinted in separate volumes, 1895, pars. 157-175, in lecture K.

[37] In the *Elements of Politics* by S. Leacock (ed. 1914), Part I, Chapter VI, is supposed to deal with interstate relations. It is said that "viewed in a purely theoretical light every State is an absolutely independent unity. Its sovereignty is unlimited" (p. 89); which only shows that the theory has no basis in modern fact. In Part III, Ch. III, of the same work we are supposed to hear of the modern State, and all the treatment is of State regulation of economic forces.

Aristotle identifies the "politician" with the educator:[43] and this again in defiance of the fact that organizations of all kinds were growing up and making the actual πόλις departmental.[44]

Since we are speaking chiefly of the influence of theory and since Rome provided no new philosophical idea on this subject, we may dismiss her abruptly. But the influence of *legal* theory and practice more than reinforced the absolutism of the Platonic-Aristotelian πόλις. The Roman conception of order implied subordination and not coordination. The "Senatus Consultum de Bacchanalibus" is an indication of the Roman tendency to make the State absolute over all interests:[45] and the inclusiveness of the *civitas* is to be seen in the complete subordination of other institutions (*collegia,* etc.), which has had an overwhelming effect upon the idea of the State in medieval, Renaissance and modern law.

In the Middle Ages, if we regard the Empire as the most important type of State, the simplification of functions is extreme, at least in theory; all power or organization depending on either Pope or Emperor. But in fact the politicians of the Middle Ages depended largely upon the Old Testament, latinized, in the words *rex* and *regnum.* The function of the State was, however, distinguished from that of the Church; and there was the beginning of a coordination of institutions. Again, here the men of the Middle Ages seem to deserve more credit for political perception than it is usual to give them. But they did not go far enough. Trade gilds and universities were conceived to "depend" for existence upon either State or Church:

[43] *Pol.*, III (VIII), init. 1337a: τῷ νομοθέτῃ μάλιστα πραγματευτέον περὶ τὴν τῶν νέων παιδείαν. This does not mean: "There should be State education," but "The *practical social philosopher* should concern himself with education first."

[44] The philosophical schools, for example, the religious brotherhoods and the artistic societies.

[45] Livy, XXXIX, 18, cf. my *Political Ideals* (3d ed.), pp. 66 et seq.

and all medieval thinkers were confused by their attempt to reconcile what they knew of the πόλις and the Roman *civitas* with the *regnum* and *Imperium.*[46] Thus the first beginnings of coordination and of a development away from absolutism or inclusiveness were easily destroyed in the Renaissance.

The anarchic tendencies of private judgment in the Reformation led the saner reformers to exalt the power of the State. Both Luther and Zwingli tended to reaction in this matter, because of the danger of a dissolution of all organized society. The time for coordinating institutions had not come: one or the other had to suffer, and the Church became a department of State: not, however, without an effort in the other direction. Calvin, attempting to keep the two functions distinct, may have made the State into a church: but Roger Williams (and he is a type of others) goes so far as to say that "church and civil government are not inconsistent but *independent.*"[47]

The current, however, set strongly toward absolutism. In Bodin, in spite of his idea of "sovereignty," we find a recognition that other institutions than the State existed before the State.[48] The right conclusion is not drawn; for we are told that other communities now owe their existence to the State. Numa, says Bodin, established *collegia* in Rome, and the Romans suppressed the Bacchic society. So the dead hand covers the eyes of a great man. Grotius engagingly declares the State to be the "perfect" community, whatever that may mean.[49] Machiavelli justifies all means for the preserving of the "State," but never

[46] This confusion is well described in Gierke (*Pol. Theory*, etc., Eng. trans. p. 96) and may be seen operating in a great man in Aquinas's commentary on Aristotle's *Politics.*

[47] *The Bloody Tenet*, Ch. 83.

[48] "Le mot de Communauté est commun à la famille, au collège etc. *De la République*, Bk. 1, Ch. 8. Cf. my *Political Ideals*, p. 135.

[49] *De Jure*, etc., I, 1, 14, "Civitas est coetus perfectus."

dreams of advocating moral or immoral extremes for any other institution:[50] and in this again he is arguing from the devotion to the State in his purely imaginary Rome. Hobbes writes that "a Church is the same thing with a Civil Commonwealth";[51] and against the maintainers of "spiritual" institutions, he says that both laity and clergy "depend on the Civil Soveraign." Other institutions than the Church are hardly mentioned.

The theorists of the French Revolution were all governed by the Renaissance and Enlightenment in the amount of the functions they attributed to the State. The destruction of the theocratic basis for power and its dynastic embodiment left the absolute and all-inclusive State still untouched. The State took over many of the illegitimate powers of the king. Even Rousseau, who cannot be said to have loved absolutism, says that man was wild and endangered, and, looking about for safety, found—the State![52] The State is defined as "une forme d'association... par laquelle chacun s'unissant à tous, n'obéisse qu'à lui-même et reste aussi libre qu'auparavant." So also the Revolutionary declaration of August 18, 1792, says, "L'Etat ne doit souffrir dans son sein aucune corporation." The result in modern times was the suppression of religious associations, which, whether justifiable or not, was based on an antiquated idea of State "inclusiveness."

To pass to later times, war once again weakened all social development, and Hegel in the *Philosophy of Right* makes the State the highest society. It is not clear whether he includes in it all institutional functions. Of other institutions only the family is adequately treated. In the *Phi-*

[50] *Lev.*, III, 10; cf. Part II, 29.

[51] *Disc.*, III, 41: "Dove si delibera al tutto della salute della patria, non vi debbe cadere alcuna considerazione nè di giusto nè d'ingiusto." It will be noticed that the State for emotional appeal becomes "la patria": but many peoples have a "patria" who have not a State of their own.

[52] *Contrat social*, I, 6.

losophy of Mind (par. 546) he says that "the state of war shows the omnipotence of the State": and he reduces the Church to "the Protestant State" (par. 549)! Wallace, his translator and interpreter, tells us (p. cciv, Clarendon Press edition) that this is "professorial socialism," and that the culmination of "the Spirit," whatever that is, is "the supremacy of the eternal State." But, I confess, "the Spirit" takes the whole matter completely out of my ken: so that I shall say no more of Hegel.

The Hegelians are amusing. Bluntschli devotes a chapter to the chief differences of the Modern State from the Ancient and Mediæval.[83] There is the barest reference to other institutions, and their international character is not recognized: he speaks as if the State were highest and best of all, and adds the ludicrous nonsense that the State is a masculine and the Church a feminine institution, presumably because of the German language! Bosanquet is absolutist in the Hegelian sense: and he goes so far as to say that in art, philosophy and religion social relations are not prominent![84] These are apparently exercises of the free individual: but perhaps here also we have some of the mysterious workings of the Hegelian Spirit.

It is well known that the English tradition of the nineteenth century was against State absolutism; but it was mistaken from our present point of view, because it contrasted the State with the unorganized and uninstitutionalized individual. This was a vital mistake, not only in conceiving a plan of action but even in the perception of fact, for what is to be contrasted with the State is not the individual, but (1) other associations for other purposes, and (2) society as a whole.

The evil tradition of atomic individualism has affected even modern political thought on the limits of State power.

[83] Bk. I, Ch. VI.

[84] *Phil. Theory of the State*, in fine.

Hence Sidgwick, who corrected most of the mistakes of Mill and Spencer, speaks as if in the case of divided allegiance, even recognizing voluntary associations, the State must be the aggrieved party.[55] He has some insight, however. Churches, he says, supply needs "which it would be desirable for Government to supply, if it could do so effectively," which we may take to be a recognition of the departmentalizing of "politics" in modern times, for it is implied that the State cannot be a church and, one may suppose, neither can it be a trading company. But Sidgwick does not seem to recognize that men are, in fact, united by institutions for other than political purposes across the frontiers of State or nationality.

In Germany Jellinek subordinates the Church in his opposition to "Dualismus":[56] he recognizes the importance of international associations, but not with reference to a division of social functions. Eucken, however, has protested against the Hegelian State. "The spontaneity and the wealth of life suffer from the tendency to increase the power of the State.... The State is inclined to look upon science and art and chiefly religion and education, especially with regard to that which they achieve for the aims of the State.... The Germans especially have much to do in this matter and there is much at stake."[57] As certain of their own prophets.... we need say no more.

Enough has been said to show that the increasing complexity and diversity of institutions other than political have not been reflected in political theory: nor has any philosophical theory of the State allowed for the immense difference this must make even to purely political facts.

C. DELISLE BURNS.

LONDON, ENGLAND.

[55] *El. Pol.*, Ch. 28 (ed. 1897), p. 577.
[56] *Op. cit.*, Ch. 10, par. 5.
[57] *Life's Basis* (Eng. trans., p. 359).

NATURAL CHECKS ON HUMAN PROGRESS.

IN times past the poetic imagination has created fanciful pictures of a Golden Age when the world was young and when mankind was innocent and happy, pictures like that, for example, of the Garden of Eden before the "fall" and before the coming into the world of sin, work and death. Traditional theology has ascribed evil to man's waywardness and departure from the perfect conditions which God established in the beginning, in the dim dawn of human life. Modern evolutionary ways of thinking, however, have turned man's face to the future instead of to the past in the universal quest for a perfect world and a perfect social order. The age of innocence has come to be looked upon as a final goal to be achieved, not as the first condition of man. The picture that Thomas Hobbes gave us in the seventeenth century of the life of primitive man as "poor, nasty, brutish and short" was like a forecast of nineteenth-century Darwinian conclusions. To many it now seems easy to conceive of a genuine Golden Age that is to come as the final fruitage of the tree of human life, the roots of which are fixed deep in the soil of past struggle and suffering. Mankind has ascended from a brute ancestry; but, just as the rose, with its roots in the dark soil, is none the less beautiful and fragrant, so the human race of the future may acquire a happiness and perfection none the less complete for having sprung from a lowly origin.

Such, in brief, is the optimistic story told by many

readers of the evolutionary records. If, however, one desires to be guided by the facts and by the sober truth, one should examine with care the foundations of all evolutionary theories that are completely optimistic in regard to the possibilities of the future. The fact of present suffering and dissatisfaction is obvious. The fact of much injustice and of many social ills that might be remedied is obvious also. But the views of the would-be reformer who assumes the possibility of the final elimination of all social evils and the consequent attainment of a state of perfect human happiness, are as unscientific as the views of the poets who have beguiled man's fancy with stories of a Golden Age in the past. So far as ideals are guiding stars of human conduct, they are valuable, no matter how completely incapable of realization, or perhaps just because of being unrealizable. As Browning says, "A man's reach should exceed his grasp." But when poetic ideals are presented in the guise of prosaic facts, the intellect is in danger of stultification.

It is with the purpose of disinguishing between fact and fancy in sociological theory that I am attempting to point out certain natural checks on human progress. Two errors are at the basis of all social theories which postulate the possibility of the eventual elimination of all human ills. In the first place, in all such theories there is the failure to take sufficiently into account human nature itself, and the limitations imposed upon human development by the facts of heredity. Thus the first great check upon the perfectibility of human nature is, paradoxical as it may seem, human nature itself. In the second place, in all Utopian theories there is neglect of the inevitable limitations imposed by the physical environment in which human life finds itself placed. The sciences teach us that the world was not made for man. The universe is in debt to no one for a luxurious life, nor does it owe any one even a bare

living. Man's life has always been maintained, and must always be maintained, through unceasing struggle with a physical environment which is indifferent to human weal or woe, and from which the means of life must be wrested by persistent human effort. For these two reasons, therefore, namely, the limitations of human nature and of inanimate nature, the upward progress of mankind can not be indefinite.

Two views of human nature, contrasting in the extreme, have been held in the past. According to traditional Augustinian and Calvinistic theology, through Adam's sin, which has become fatally hereditary in the race, all of mankind has been corrupted. Theological views of original sin, infant damnation and the like, are but slightly familiar to the modern world, but they have been of immense importance in the history of theology. Another view of human nature was promulgated influentially by Rousseau in the eighteenth century. His book *Emile,* valuable in many respects and now regarded as the corner-stone of modern educational theory, proclaimed a view of human nature diametrically opposed to the Augustinian view. The very first sentence of the book makes the assertion, "Coming from the hand of the Author of all things, everything is good." Rousseau refers especially to child nature, which he regards as wholly good. Moreover, according to Rousseau, but for errors of individual development due to imperfections in our educational methods, adult human nature would remain as completely perfect as child nature. Rousseau was a sentimentalist, and his views concerning the natural perfection of man seem as fantastic to the modern scientific mind as do the old theological views of original sin. This romantic conception of human nature, however, has persisted in many quarters, and forms one of the basic errors in the reasoning of many social theorists.

Is human nature inherently good, as Rousseau claimed,

or wholly bad, as Augustine asserted? As in the case of all other extreme theories, so here, the truth lies midway between the extremes. Human nature is partly good and partly bad. Modern studies of the original nature of man have given us lists of inherited tendencies. The most important of these tendencies are the instincts, of which man possesses a greater number, according to William James, than do the animals below man. All of the instincts have been biologically useful at some time in the past. Man's ancestors were prehuman many times longer than they have been human, and modern man's human ancestors were savages many times longer than they have been civilized. The instincts are an inheritance from the jungle existence of countless generations, which struggled with tooth and claw, and then with war-club and battle-ax, for existence and for supremacy. In former times the instincts were all useful, under the conditions of jungle and of savage life; but their strong persistence as a fundamental part of human nature after civilized conditions have been established, creates numerous problems, since the instincts are not always useful now. Many of the vices and crimes of modern man are the result merely of the exercise of normal human instincts, though some of the virtues also of modern man are equally the result of instinct. Egoism, for example, is based on those instincts which have contributed directly to individual self-preservation; but altruism also is instinctive, being an outgrowth of the parental and the gregarious instincts, which have been instrumental to the preservation of the social group. Original human nature, therefore, cannot be called wholly good or wholly bad, but both in some degree; and the degree of goodness or badness is to be measured in terms of the ethical quality of the instincts when exercised under modern conditions.

From the fact of the non-inheritance of acquired characteristics, a fact established by Weismann and widely

accepted by biologists, there follow certain other facts of importance for education and for social progress. Civilization, by which we refer to a condition of culture characterized by a complex development of religious, social and political institutions, together with achievements in literature, art and science, is wholly a matter of acquired characteristics. Consequently, civilized ways are not inherited. Sometimes we speak of social heredity in explaining the transmission of cultural elements from one generation to the next. Social heredity, however, is not really heredity, but rather education in the broad sense of the term. Civilization is an artificial condition, maintained at the cost of unceasing effort. Each new generation is born with an inherited equipment of instincts and capacities little superior to the equipment of our savage and barbarous ancestors at the stage of evolution immediately preceding the dawn of civilization. If it were possible for one generation to be left entirely to itself, and if all influences from a civilized environment might be excluded, this segregated generation would relapse completely to a state of savagery. Romulus and Remus, the legendary founders of Rome, were said to have been suckled by a she-wolf, which had saved them from death through exposure on the bank of the river Tiber. The impossibility of any such occurrence as a matter of serious history is obvious merely from the fact that acquired characteristics are not inherited. Romulus and Remus were born of (somewhat) civilized ancestry; but, if they had actually been reared in the wilderness by wolves, they would have been lacking in all the essential qualities of civilized life, and consequently they would have been incapable of founding a city. Capacity is inherited, but the direction in which attainment is to occur depends upon the directing influence of the environment.

Original human nature, unmodified by civilizing influences, is thus seen to be necessarily far from perfect

when judged from a cultural view-point. By original human nature is meant human nature in its hereditary aspect, and most of the hereditary elements come from an immemorial, uncivilized past. Instincts evolved in the jungle and tendencies bred in savagery constitute the fundamental material with which the sociologist must deal. If acquired characteristics were hereditary, it would be possible for each generation to begin where the last left off, and to forge ahead rapidly. Many theories of rapid social progress assume unconsciously that this is possible. If the whole educative effort of each generation might be expended in projecting the next generation forward, then there would be no limit to the possibility of social advance. But a large part of the educative effort of each generation must be utilized in the never-ending process of bringing the new generation up from its original, primeval condition to the existing level of culture. Merely to maintain the present status of culture requires ceaseless effort, and relapse to the primitive is only too easy at any time, and too rapid whenever it occurs. Each new generation begins, not at the stage of culture reached by the preceding generation, but at practically the same point at which the preceding generation started. Such a thing as a modern infant does not exist. An infant is no more modern or civilized in the twentieth century A. D. than was an infant in the twentieth century B. C. Moreover, each new generation has to begin as infants, not as adults. Some forward progress is possible, however, since the recapitulatory part of education, the retracing of what past generations have achieved, can be shortened somewhat, so that, to a limited extent, education can be, and is, of a genuinely prospective sort. A study of history shows that genuine progress has occurred, along with a certain amount of retrogression in some respects. Greek and Roman civilization, for example, was higher in some respects than modern civilization; while in other

respects, especially in the development and application of the sciences, the present stands supreme in comparison with all the past.

Though social progress is possible, and though it may be almost limitless in some directions, still a real Golden Age in the future is impossible if for no other reason than that each new generation must begin anew and relearn through painful effort the civilized ways of the past before forging ahead to new achievements of its own. In addition to this necessity of a certain amount of recapitulatory education, there is inherent in human nature another and a more serious limitation upon progress. I refer to the persistence in human nature through the force of heredity of traits and tendencies which smack so strongly of jungle and of savage life that their adaptation to civilized conditions can never be made perfect. The first check on social progress due to causes inherent in human nature is thus the failure of civilization to maintain itself through hereditary transmission, while the second check is of just the opposite sort—the too strong persistence through heredity of uncivilized traits which hark back to the primitive and which cause maladjustments in any refined society in spite of the best efforts of education.

This second point may be made clear by reference to specific problems that arise in connection with the necessary redirection in modern society of some of the instincts. A leading contemporary educational psychologist, Professor Thorndike, has defined education as the prevention and the production of changes in original human nature. Some elements of the child's innate endowment are good, and change of them is to be prevented; but other innate tendencies are bad and need to be changed in order that the individual may be fitted for a moral life. Nearly all of the instincts may be turned in some degree to desirable moral uses, but many of them tend constantly to express them

selves in injurious and immoral ways. This is the case, for example, with pugnacity. Its utility in past ages, in its original form of individual and group fighting, is obvious. Its present-day expression in this primitive form is considered immoral, however, in the light of the highest ethical standards. This instinct may be utilized, nevertheless, through sublimation, by which process other objects than the instinctive ones are substituted for it to act upon. It furnishes enormous energy, making possible some of man's best achievements. The social worker, for example, may utilize a sublimated form of pugnacity in fighting evil conditions and in feeling righteous indignation toward wrong. The complete sublimation of this or of any other instinct, however, is impossible; and it seems likely that pugnacity will find unsublimated expression indefinitely in the form of actual warfare. Consequently, the greatest problem to be faced by any league of nations that may try to prevent all wars arises from fundamental imperfections in human nature. Fear, also, like pugnacity, is an important instinct. Its necessity for the survival of the race in earlier times is clear. Through it dangerous situations have been avoided. There have been times when, from the point of view of individual and group safety, discretion was the better part of valor. Fear is capable of being sublimated and made to possess moral value when vice, dishonor and the like, become the objects feared. In the training of children fear of punishment is utilized as an incentive, though less frequently now than formerly. But fear has dangers for mental health. For example, unreasonable fears often arise in childhood, and these may mar the whole future development of the individual. Fear is so deep-seated in the race that it can never be completely eradicated; and, so long as it persists, universal happiness will not be attained.

Other instincts also have their bad as well as their good sides. That curiosity is recognized as being sometimes

bad is shown in the warning that "curiosity once killed a cat." When sublimated in the form of intellectual curiosity and of religious wonder, this is a valuable instinct; but will such unsublimated expressions of it as, for example, the improper prying into other people's affairs ever be stamped out, and will the Golden Age be really golden until such expressions of curiosity cease? The instinct, however, which has always caused the greatest amount of trouble of any, and the proper moral regulation of which has been society's most difficult and unsuccessful task, is the sex instinct. This instinct is the source of life's greatest happiness, but also of life's greatest misery. Its vital importance for racial survival has led to its becoming highly developed in ages past—far too strongly developed when considered in relation to the conditions of civilization. In civilized society complete expression of the instinct is morally impossible. Under the influence of moral, religious and esthetic ideals much of its insistent energy can be sublimated into the very highest forms of expression, such as mystical worship and artistic creation and appreciation. For but few individuals, however, do art and religion furnish a sufficient safety-valve for the instinct, and for even these few the stern repression that is necessary as a part of the sublimation process leads often to neurotic disturbances. For the great masses of mankind the sex instinct is the source of much disease and crime. Never can the race survive the disappearance of this instinct, but never can the race be free from disharmonies so long as the instinct persists. Neither with it nor without it will a perfect social order ever be possible.

A common fallacy in the thinking of numerous theorists is that of ignoring the biological checks upon the development of human virtue and intelligence. The individual who has achieved intellectual emancipation sometimes tends thenceforth to judge society as a whole in terms properly

applicable only to a few, and to think that the evils of ignorance and of superstition may eventually be cast off by every one. Then, with reason at the helm of life, all will be well with mankind. Thus runs the argument. The facts seem to indicate, however, that reason is relatively sterile in the biological sense, and that it is incapable of propagating itself extensively enough to become universal. The great intellects of history, our Platos, our Kants and our Newtons, have been childless. The intellectual and highly educated classes have always tended to be somewhat infertile. The population is, as a general rule, being constantly recruited most plentifully from the less intelligent portions of society. Saintliness and wisdom are hard pressed in their efforts to maintain themselves biologically

In several ways, therefore, it is seen that human nature itself limits the prospect of indefinite human progress. Progress is limited also by inanimate nature. When theorists lay the blame for human suffering wholly upon the shoulders of certain unjust classes of society, or upon defects in the educational system, or upon some other social imperfection, they are apt to assume erroneously that, if only justice among men prevailed, nothing would remain to mar the picture of perfect happiness. A proper biological perspective of human life corrects such an assumption. The most fundamental law of the animate world is one of prolific multiplication far beyond the capacity of the environment to supply food. This law applies to man no less than to the lower animals. Of course, through the proper application of science to nature, the physical needs of an enormous population can be supplied. I would not argue specifically, as Malthus did, that the needs of the increasing population for food are constantly exceeding the food supply; but I would point out that this is the universal tendency in the world of life below man, and I would apply the principle more broadly in the human sphere, not limit-

y to the question of food, since "man does not
d alone."
mate nature limitless in resources and capable
ıg sometime a perfect home for a perfect so-
s the physical world made especially for man's
enjoyment? Has mankind any inherent right
life and luxury from nature? From the bio-
-point, the answer to all these questions is nega-
seems like an intruder into the vast world of
ıature, which existed long before the appear-
and which will survive life's extinction. From
›int of the sciences, the physical universe is
fferent to the vital needs of plants and animals.
ns have simply thrust themselves into the cracks
:s of nature, encroaching everywhere upon an
. Mankind is in no position of special privilege.
y yield an abundance to meet the needs of man,
far as man asserts himself in a ceaseless effort
t he needs. It is a case of nature helping only
help themselves. That human needs may all be
satisfied some day from nature's storehouse is
on to be proved or disproved, but not to be as-

Schiller says in his *Riddles of the Sphinx*: "To
nan the world is a terrible affair, replete with
e horrors, whose burden was alleviated only
ıitations of his imagining. It is still so beset
:rs that science may legitimately wonder whence
s the strength to sustain the unequal struggle
osmic forces" (3d ed., p. 465). The evidence
ciences of geology and astronomy is opposed to
ption that the physical environment will even-
haped wholly to human uses and made produc-
isfactions for all human needs. Not only is the
:e of inanimate nature to man's present desires

shown by catastrophes such, for example, as ruinous earthquakes and volcanoes, droughts and floods; but the prospect for the distant future is one of final disintegration and destruction rather than of indefinite improvement. In *The Foundations of Belief* Mr. Balfour has pictured the last state of our portion of the physical universe in the following words: "The energies of our system will decay, the glory of the sun will be dimmed, and the earth, tideless and inert, will no longer tolerate the race which has for a moment disturbed its solitude" (p. 31).

Although social progress can not continue without limit, it may, nevertheless, be great even beyond the power of the twentieth century to imagine. Human nature itself limits progress in the specific ways that have been pointed out; but, nevertheless, human nature will unquestionably be more effectively adjusted to the environment by the better educational methods of the future, and it will be improved fundamentally through the widespread application of eugenics. Inanimate nature, like human nature, sets limits to progress, nor will it every be wholly kind to man; but the future progress of the sciences will enable man more and more, within limits, to bring the physical world under human control.

Human nature is such, however, that it will never be completely satisfied with a purely positivistic goal of social progress. There will always be felt, on some occasions, at least, and among some persons, the need of a romantic religion. "How painful is the actual world—the painful kingdom of time and place," said Emerson; and then his world-weary soul sought refuge in the Over-Soul. Thus has it always been with men of imagination, sensitive to the transcendental yearnings of humanity, and thus will it always be.

WESLEY RAYMOND WELLS.

COLBY COLLEGE.

CRITICISMS AND DISCUSSIONS.

NIETZSCHE—TRAFFICS AND DISCOVERIES,[1]

I.

Without doubt, the Bird of Freedom and the Star-Spangled Banner are venerable symbols. But, like the British Lion and "the flag that braved a thousand years the battle and the breeze," they may deck the triumph of campaign buncombe or propagandist windjamming and yet, in due time, escape these base uses unsullied. For, "bulldozia" happens to be a temporary aberration in the lives of average men, even if irresponsibility and conceit, ignorance abetting, are seldom far off. On the other hand, when propaganda plasters a thinker, advertising him an intrusive nuisance or worse, the stigma tends to produce permanent misunderstanding. Many recent proofs might be led for the case of Nietzsche; one may suffice. "It is doubtless true that the Bismarckian doctrine of 'blood and iron,' *etc. ad nauseam* are largely due to Nietzsche, Treitschke, and Heine and others of recent date who have continuously preached the doctrine of German superiority." Small wonder that the perpetrator of this historico-philosophical flub-dub should have been described—by a friendly hand—as a "county chemist, who left the bedside of his patients long enough to call attention to the fact that Nietzsche taught pernicious doctrines." Beer-analysis and the bedside are prone to interfere sadly with comparative study of a somnambulistic pamphleteer (whose pamphlet runs to several fat volumes from which, as Nietzsche said, intelligence had disappeared); a contemner of "half-and-half standpoints" (whose canon is written in twenty-three volumes); and a quaint, vivacious, scathing spirit (also a maker of many volumes); not to mention the anonymous

[1] *Nietzsche the Thinker: a Study.* By William Mackintire Salter. New York, Henry Holt and Company. Pp. x+539. Price, $4.00 net.

"others of recent date" (whose output may well fill a library). In short, "patriotic" gregariousness and half-cock garrulity do not favor the patient toil necessary to appreciation of the reflective and solitary.

Accordingly, seeing that we have had a surfeit of the "red-blooded American" who views the "Great Republic" as if it were merely a series of cinematic thrills and conventionalizes Nietzsche into a barker for poisonous patent medicines, it is a welcome relief to light upon Mr. Salter's volume. Without delay or circumlocution, one may say at once that this is *the* English book on Nietzsche. Indeed, such are the virtues of perspective that I doubt whether Mr. Salter is excelled by Prof. Raoul Richter, whose magistral *Friedrich Nietzsche, sein Leben und sein Werk* is the single study fit to dispute pride of place with the American monograph. Steady application "in lonely ways and studies" giving perfect familiarity with the primary sources, and with the greater part of the extensive secondary material, has wrought an authoritative pronouncement—by a dyed-in-the-wool American Protestant, of all people. Moreover, the book does honor to our scholarship, we have too few of its kind. Speaking of other works on the subject, Mr. Salter complains, with ample justification, "What, however, does not seem to abound is knowledge of the object slain, or to be slain, i. e., some elementary and measurably clear idea of who, or rather what, Nietzsche was, particularly in his underlying point of view" (p. vi). And, referring to his own effort, he modestly suggests, "As for criticism—unquestionably the thing of final moment in relation to every thinker—if I can only help to make it in this case a little more intelligent in the future, I shall for the present be satisfied" (p. vii). He may rest assured that he has seen of the fruit of his labors, that his aim has "better bettered expectation."

More than likely, it is prudent to note that "the book was in substance written before the present European War, and without a thought of such a monstrous possibility" (p. v). An excellent omen. For, during the period of Mr. Salter's travail with Nietzsche, the attitude of protest, so productive of false stress, was not thrust upon him rudely. Hence, exaggeration, moral strain and the temptation to traffic in catch-phrases, are absent. Nevertheless, Nietzsche *is* Mr. Salter's hero, and, unavoidably no doubt, a certain emphasis ensues—an emphasis of appreciation, to be sure, rather than of headlong discipleship. "I do not wish to prophesy, but I have a

suspicion that sometime—perhaps at no very distant date—writers on serious themes will be more or less classified according as they know him or not; that we shall be speaking of a pre-Nietzschean and a post-Nietzschean period in philosophical....speculation" (p. 4). I cannot but diverge here and, in order to make our differences plain, am bound to outline my own experience. It may possess impersonal interest. For, angle of approach may very well determine one's general estimate of any author, to say nothing of a "free spirit" on the Nietzsche scale.

Reverting to several ventures in Germany between 1876 (the earliest) and 1885 (the latest), I cannot recall that Nietzsche ever presented himself or was presented as a force important enough to demand instant reckoning. Kant and Hegel were the ruling orbs, even if interference rays from Schopenhauer had begun to attract attention, thanks to the *popular* vogue of Hartmann's *Philosophy of the Unconscious*. Trendelenburg cut no small figure among students; the neo-Kantian movement had gathered headway; indeed, oblivion was already overtaking the Platonic element in F. A. Lange's *History of Materialism*; and the double-refraction process peculiar to Lotze's irenical spirit found favor with so many that Berlin cast envious eyes at Göttingen. But all these, even Schopenhauer, harked back to the two great luminaries, and—criticism attaches the critic no less than the disciple to some mighty master, as we are apt to forget. Accordingly, *Facharbeit*, ever more *Facharbeit*, particularly in history of philosophy, dominated us. Was not this our real quest in any case? I at least left Germany with a head full of the sort of thing to be found in Zeller, J. E. Erdmann, Friedrich Harms[2] and, significantly enough, A. E. Biedermann.[3] A tincture of Schopenhauer (on whom I labored during the eighties) there may have been, but Nietzsche lay entirely below the horizon. Nor can I recall that I ever heard of him effectively during fifteen months spent at Paris and Rome in 1881-82.

He was brought to my attention first in 1887, by Ernst Elster (afterward professor at Leipsic), then my colleague at Glasgow. But in these days Elster was immersed in Germanic philology, and did not insist upon the new star. Nor was this surprising for other reasons. Nietzsche himself tells us, in 1887, "that in fifteen years the dear Germans have not managed to write so much as one *moderately* serious and thoroughgoing review of any one of my twelve

[2] *Die Philosophie seit Kant*, 1876.

[3] *Christliche Dogmatik*, 1869; 2d ed. 1881-84.

volumes." It thus fell out that he was not thrown at me till 1890 when, by a lucky accident, Alexander Tille, of translation fame five years later, arrived upon the Glasgow scene straight from Leipsic. Tille—so report ran—represented the very last word in modes and moods fashionable with youngest Germany. He was understood to be the Alexander Lauenstein of the *Magazin für Literatur* of the eighties, the Kurt Grottewitz of *Neues Leben,* and reputed to have had some conspicuous hand in a novel, *Vor zu Laufgang,* scandalous enough to have earned suppression even in Germany. I never could get a sight of this book; but, in any case, Tille appears to have kicked over the traces with shocking effect upon the Saxon *Philister.* He turned out to be a furious Nietzschean, his *Von Darwin bis Nietzsche* rumbling in his head already. His curiously "foreign" gift of sentimental exaggeration did not reassure a Scots scholar, although his vast knowledge of the Goethe literature proved impressive. Nor did the active historians of philosophy lend much color to his ecstasies, as I used to urge in rebuttal. To be sure, Erdmann's third edition (1878) fell early enough to render total silence explicable. But Falckenberg (1885) dismissed Nietzsche with bare reference, as a disciple of Schopenhauer; Windelband (1891) inclined to number him with the poets; while Weber (1892) treated him once more as a mere foot-note to the Frankfort pessimist. Learned Americans who, as we heard, were absorbing things German with avidity, gave no greater encouragement. The painstaking B. C. Burt (1892) and the brilliant Royce (1892) preserved the silence of ignorance, discretion or, mayhap, contempt. Thus Tille, who harped on the "blond beast," gave a luckless impression of subjective *Schwärmerei,* and I was inclined to smile, I fear. At last, in 1894, I heard something which startled me. Early in this year, I had an intimate conversation with Otto Pfleiderer, then Gifford lecturer in the University of Edinburgh. Although he was set upon denunciation of Ritschlian and neo-Kantian misdeeds, I contrived to introduce Tille's tall talk, and sought enlightenment. Pfleiderer had never heard of Tille, but he was perfectly open, even decisive, about "the Nietzsche cult," as he termed it. "Yes," he summed up gravely, "Nietzsche has *hypnotized* Young Germany."

Retarded through seven years by acquisitive preoccupation, vague report and hectic pæan, I now began to suspect that we might be confronted by a person who "hurts, makes afraid and wastes," assuredly with a type of experience demanding further study. Five

years later, at the University of Michigan, I felt justified in taking Nietzsche as the subject for a proseminar, encouraged by the presence of unusual students, several of whom are now shining lights in our academic firmament.[4] The venture proved unsuccessful, all things considered. As Mr. Salter himself has been good enough to suggest to me, Nietzsche is too difficult, makes too many demands in the way of background, even with exceptional students. I did not repeat the course. But I had arrived at a definite conclusion, and have found no reason to alter my opinion. Nietzsche must be rated the most symptomatic spiritual phenomenon cast up by Europe in the last quarter of the nineteenth century. Yet, he is an index rather than a synthesis, occasion for philosophy rather than philosophy. I thought, and still think, of him as a telltale like Samuel Butler, whose *Life and Habit, Evolution Old and New* and *Luck and Cunning* I had read ere I came to know the Nietzschean reaction to "the struggle for existence." Credit me with no perspicacity on this score: Butler had been introduced to me by my Darwinian kinsman, the late George John Romanes. Similarly, Nietzsche seems to me a manifestation of a period unfavorable to systematic philosophy. I think of him much as I think of Empedocles, Diogenes of Sinope and Marcus Aurelius; of Montaigne, Pascal, above all, Voltaire. At the same time I strongly suspect that, although outwith the apostolic succession of major thinkers, he owed most to Plato.

The moral is plain enough. Ere I knew Nietzsche my philosophical standpoint had been reached. He might sing a new song to the Lord, as is the manner of genius, but I found no evangel. Thus the phrase, "a pre-Nietzschean and a post-Nietzschean period in philosophical speculation," leaves me cold.

Now, although Mr. Salter nowhere reveals his angle of approach, it is patently not mine. More than likely, when he encountered Nietzsche, perhaps by way of Schopenhauer, he was still eager "to find the thought that shall stand over mankind as its star" (p. 472). I was not. Accordingly, any differences that separate us are traceable, not to an attempt on my part to find fault with work so competent, but to our contrasted drifts. Mayhap, it comes to this. Mr. Salter, eager for something he can unconditionally obey, the survival from his Puritan ancestors, tends to emphasize the

[4] I have heard it said that these were the first university lectures on Nietzsche. Needless to recount, this is a blunder. So far as I know, the first lectures on Nietzsche were given by Georg Brandes, at the University of Copenhagen, in 1888.

Nietzschean intellect; the coercive must have warrant from thought. I, bred in what some (a little thoughtlessly) call "intellectualism," cannot see it this way. For me, paradoxically enough, Nietzsche imports much more than "thinking." But, let divergence play ever so large a part, one must insist upon the manifold service rendered by Mr. Salter. He has rescued Nietzsche from vulgarization by showing the sole way to counteract the irresponsible species of chatter that issues too often in mischievous absurdity.

Nietzsche's oracular style, his conceit to compress a volume into a sentence, his aphoristic profusion and his positive affectation of the "startling" (which he himself admits), have much to answer for. Nor has he been helped by the silly assertions and, no less, the stupid attacks upon great thinkers which some of his self-important disciples appear to deem incumbent upon them. Those who use English often contrive to be more ridiculous than their continental brethren, thanks to that vast ignorance of the history of philosophy characteristic of, or affected by, the younger generation, who foist propaganda upon us under the curious delusion that it betokens deep thought or remarkable originality. Acidulated perversity of this sort is totally absent from Mr. Salter's book. Care and moderation prevail; nay, the very gravity is too grave, perhaps, for a humorist like Nietzsche. Yet, compensations abound. In the first place, it is insisted that Nietzsche must be read as a whole, if not necessarily in historical order then certainly with particular reference to the cultural forces playing upon him at a given time. Again, as a natural consequence, current misapprehensions are dissipated. not so much by specific criticism as by a unitary exposition whereby Mr. Salter proves that, despite puzzling changes of stress, a few fundamental ideas control the total outlook.

All this admitted, and much else (for it is easy to wax enthusiastic over Mr. Salter's performance), the question still remains. Why place Nietzsche upon a *philosophical* pedestal? I can no more than guess! It seems tolerably plain that, as a student, Mr. Salter struck the doldrums of philosophical teaching in this country, when maiden uncles prelected in delicious unconsciousness of what had really been afoot since the *Critique of Pure Reason,* and that, after many days, he found in Nietzsche the one man capable of "putting in a downright lick between the eyes of humbug." Subjected to the precious conventions of the American denominational college as they bloomed in the latest sixties, he may have been permitted to

light upon Cocker's *Christianity and Greek Philosophy, or the Relation Between Spontaneous and Reflective Thought in Greece and the Positive Teaching of Christ and His Apostles* (1870), a work well calculated to bemuse him with a good deal of amazement, although rather by contrast with the startling jubilations of a contemporary book, *The Birth of Tragedy*—for Cocker sought divine approval rather than human enlightenment! Passing thence to the "divinity schools" of the seventies, he may have tackled the *Critique* in a general way and, possibly, Wallace's *The Logic of Hege* (1874) which, belike, kept the "secret" tolerably well, even if not so inviolate as it had been under the spell of Stirling's loquacious taciturnity. But, secret or not, it was necessary to say something about it, in order to offset the enormities of the abominable F. C. Baur. Under the assault of the Tübingen School, discretion would have been a vice.

Accordingly, it may be affirmed that Mr. Salter did not tread that veritable mill of Kant and Hegel—with Plato and Aristotle thrown in for good measure—the predestined "conditioning" with a majority of professional philosophers who were and still are his contemporaries. Notwithstanding, it would be an impertinence to suggest that he missed a background. He voyaged his own Odyssey of the spirit in his own way. I take it that he felt the powerful inhibitions peculiar to American Protestantism half a century ago: that his soul travailed greatly, forsaking at length the dogmatic implications, while retaining the sharp, almost painful, ethical interest. Indeed, *mutatis mutandis*, his experience in relation to his native environment may very well have been akin to that of Nietzsche himself. And, seeing that philosophies always portend an emotional element, that, by consequence, their moral implications bulk much larger than is sometimes admitted, Mr. Salter built his temple anew in his own fashion, stimulated latterly by the mastering issues latent in Schopenhauer, full-throated in Nietzsche. On no other hypothesis can I understand his complete and refreshing detachment from (for example) everything underlying the principal contribution to ethical theory in the English-speaking work of his own generation, Green's *Prolegomena to Ethics*. Traces of the influence of Caird, Bradley, Bosanquet and Royce are equally conspicuous by total absence. This is what I imply by "the virtues of perspective" mentioned above. Nietzsche did not "shock" Mr. Salter to such an extent that he turned away breathless. No inwrought philosophical

outlook had to be foregone, no system of coercive theological ethics had to be shattered. It never occurred to him, as it occurred to not a few reputable persons, who took a peep and then fled, that Nietzsche must needs be a species of privileged lunatic. Hence, as I see them, the great strength, and the main weakness of his book, when set in a scheme of values that left Mr. Salter untouched.

In a word, the grand manner of Puritanism had been overset, thanks to the picayune deeds now charged upon Providence. The Platonic element in the theological *Weltanschauung* suffered a parallel sea-change such that metaphysics came to look like a "higher kind of swindle," as Nietzsche said. Small blame to him that, caught in the backwater of the seventies, Mr. Salter hardly realizes through what an arid land, forbidding and trackless, a thinker must win to *intellectual* reality worth while. "How charming the perfection and pulchritude of the leaves, the flowers, the fruits....Oh! the glorious goodness of our Deity in all these things!" After portentous labor, the long-drawn abstractions of the "divinity school" brought forth this mouse. Therefore, it became incumbent to eschew the *Allgemeinheit* of metaphysics, to revert to "the very dirt of private life." Naturally, Mr. Salter's conscience remained of the tenderest. So there is no cosmology, actuality is not the deepest issue of life; but ethical culture in some shape, surrounding us with a great cloud of controls, poses a new world, where East is West and West East—"beyond good and evil." As I am bound to see it, this attitude affords play for magnificent idiosyncrasy; the drawback is, it misses the scale of man's universe. In so alleging, I simply say that some ages set their dreamers too heavy a task. This was Nietzsche's fate—and opportunity. Mr. Salter is an admirable guide precisely on account of his consentaneity. Fated, he does not see clearly that "the worth of life *should* not be made to rest on uncriticized metaphysical assumptions." Accepting a dysteleological universe, where no omnipotence abashes mere men, he concludes, logically enough, that each has his practical contribution to make. "The completely ordered world remaining forever an ideal," every one can bear a hand in the resultant struggles, especially in the competition of ethical values bound to ensue. The real separateness of selves assumed, not *vivere est cogitare*, but *vive ut vivas*, stamps the human mission.

Further, if we agree that the world or, at all events, the significant world began to roll about the time of Nietzsche's death—

somewhat complacent in its stodgy gospel of output, yet already showing signs of the onset of the nostalgia that spells rebellion—there is a sense in which Mr. Salter's contention holds. For, taken on this scale, "a pre-Nietzschean and a post Nietzschean period in philosophical speculation" invite backward-looking prophecy: only to tell that Nietzsche may veritably prove the last representative of the "secret infinity" so characteristic of the essential spirit of romanticism—the ultimate romantic. *Ne plus ultra.* As for me, I have never been able to see him otherwise. We cannot understand the continuous thunderstorm reverberating in his mind unless we have due regard to the oppugnant forces that had focus there, rendering him at once so suggestive and so puzzling, so remarkable and, no less, chuck-full of impossible dogma. His phases are no accident. Take them as basis for charges of inconsistency, instability or even insanity, and you rule yourself out of court. Far rather, he was a very scapegoat, bearing the sins of the people to Azazel in the desert on the Day of Atonement.

Bred graciously in a theological family, inoculated with all the proprieties, he passed to the severe discipline of Schulpforta, where, although the mind fed soundly if not sumptuously, the soul found barmecide fare. The university followed, then in the noon of a specialism that presaged no setting. Conventional "beer-fights," accepted for a moment as proofs of assumption of the *toga virilis,* soon palled; and, later, despite magnificent philological equipment, spirituality felt itself starved. Thus defrauded, Nietzsche (who was without training in technical philosophy) took the Frankfort curmudgeon for an apostolic figure, scarcely suspecting his place and significance in the Kantian line. Rightly enough too, perhaps; for Schopenhauer, though no profound metaphysician, revealed depths and to spare in the recesses of human feeling. Nay, more, Schopenhauer drunk, not Schopenhauer sober, raised the call of deep unto deep in Nietzsche's being. The Wagner episode, ecstatic while it held, was to be a sharp two-edged sword, cutting even to the bone and marrow. The pilgrim of eternity, bereft of his "beautiful moment," came to hate guide and quest alike, not wisely but too well. Disgust and self-criticism ensued, fed partly by the horrors of war, of which Nietzsche saw more than his share; while the physical mischance that befell him appears to have induced something like hypochondria, with consequent addition to harmful nostrums. Then for a little he ploughed with Gallic cynicism, reverting

to the hardness of the eighteenth century, yet, being in the nineteenth, pondered *Darwinismus*, an issue full of intrigue at that time. But, making loneliness its familiar, the romantic soul reasserted itself and, becoming once again the pilgrim of the infinite, now on its own account and not as any man's disciple, presented the great spectacle which drew the eyes of an epoch. Finally, on or about January 4, 1889, writing from Turin, Nietzsche perpetrated the extraordinary communication to Georg Brandes, signed "The Crucified," and straightway fell upon that most tragical of deaths, death at the top. It were evidence of sanity to take farewell of him here!

II.

Pursue culture, from Tieck to Francis Thompson, whithersoever you please; insist that the main highway is hideous with the dead or moribund conventions of "Victorianism"; claim that you detect nothing save "vast increase of natural knowledge," or crude commercial exploitation, following hard upon invention; allege that the dissolution of ancient theological controls, held normative for a millennium, is the significant affair; flout the obtuseness of the *bourgeoisie*, or flaunt the glories of nationalistic statesmanship; see rose-colored with the optimists, affirming that no age was ever like unto yours, or suffer a billious pessimism that tracks pretentious materialism on every side; be "reactionary" or anarchist"; talk about "the century of hope," or bemoan the century of skepticism; in short, feel deliciously free to select any aspect for the whole truth, taking a joyous plunge regardless of depths as is the habit of many now! But recall, be your hazardous choice what it may, you will strike the trail of romanticism. Blame or praise, damn or worship, you cannot get away from it. Spiritually, from Blake to the pettiest aberrations of the "naughty nineties," from Herder to end-of-the-century neo-Fichteans, from Chateaubriand to Péguy; geographically, from Alloway Kirk to some unknown prison-house on Siberian steppes, from the English to the Italian lakes, from Jena to Concord, it haunts the pregnant phases of the moon, posing problems that admit neither solution nor escape. As has been suggested, it is more than possible that Nietzsche was the last victim of its metaphysical anguish. In any case, he was the only subject of *all* its paradoxes—generous yet cynical, audacious yet pessimistic, insolent yet humble, jeering at "respectability" yet vibrant with aristocracy, appreciative of the amenities yet implacable to the indus-

trialism on which they had come to depend, eternally young yet sick to death of the restlessness bred by pert sophistication. Insatiable therefore for "something"—whether bitter or sweet did not matter much—some "blue flower" for choice, of course, as the old lure of the Alps suffices to hint. A total stranger to the serenity of the grace of God, yet a brave knight of the Grail, eager to undergo anything in the search for some grace that passeth understanding. For him as for Tieck, "Die Scheidewand zwischen Fabel und Wahrheit, zwischen Vergangenheit und Gegenwart ist eingefallen: Glauben, Phantasie und Poesie schliessen die innerste Welt auf." How secondary the role played by the sobriety of philosophy when one views the incandescent phenomenon in this way.

From Rousseau's *La nouvelle Héloise* and Herder's *Fragmente*, through *René* and *Manfred* and "Junge Deutschland," to Newman's *Apologia*, Wagner's *Tristan und Isolde* and Swinburne's *The Hymn of Man*, how variety mocks unity for a round century, yet what community there is—in "enormous moods," and in the inevitable ache for "romantic escape." Possibly, as Mr. Salter hints, Nietzsche imports more than his predecessors, Rousseau not excepted. But, if so, we must seek the clue in the persistent integration of the community with the variety. The entire gamut of stresses is run by him; the "enormous moods" attain a veritable enormity of insurgence, destructive to the individual, full of intimation to the observer. A demoniac person confronts us—heir of all the romantic preferences as of all the romantic objects of aversion; but, wrestling with a realistic age, the victim of a twofold originality, both ends out of sight, never out of mind. Further, the romantic urge gave him no peace, a brief breathing space aside when he flirted with the eighteenth century in its Voltairean incarnation. Hence the clamor of his scorn deceived him into thinking that he had neither art nor part with his countrymen. On the contrary, despite the conceit of Polish ancestry, his was the German *ictus*. He cannot be separated from it any more than Carlyle from his inverted Calvinism, Ruskin from his altruistic loyalties of the Scots Jacobite. And necessarily. For, as Mr. Chesterton has it (with customary gay wisdom), in a rhyme now hard to lay hands on,

> "The people of Spain think Cervantes
> Is worth any number of Dantes,
> An opinion resented most bitterly
> By all the people of Italy."

No dupe of prevalent and greatly waxing nationalism, Nietzsche could not elude its clandestine blandishments. Unusual to the last degree the relations may have been; they were there. Accordingly, the best introduction to him is not to be found in philosophy or science—movements tending toward internationalism—but precisely in such a work as Heyse's *Kinder der Welt* (1873).[5] It is not that Nietzsche passed, like Swinburne, from mystic delights of Catholicism to violent transports of Tory Republicanism, wholly unaware that both imply similar presuppositions; not that, like Carlyle and Ruskin, he was beset by contemporaries who, nevertheless, embraced identical principles, nor even that, like Swinburne once more, he could abjure a kindred spirit without seeing the humor of the situation. But he did derive from the immediate cultural outlook. For example, he accepted as matters of ancient history many things, not merely debated, but burked in England. The *sancta simplicitas* of intellect attributed to Theobald Pontifex (a fellow of his College, recollect), was nowise overdrawn.[6] It is plainly inconceivable of a "reformer" who, at the outset of his career, had already disposed of that scandal-mongering unbeliever, D. F. Strauss, for a *Bildungsphilister.*

In the same way, neither the *dii majores* of philosophy—Spinoza, Hume, Kant—nor the *dii minores*—Schopenhauer, Hartmann, Dühring—haunt Nietzsche's pages; let alone authority, he even speaks of "spiritual rat-catchers." On the other hand, we constantly recognize the accent, nay the phraseology of Tieck, Fr. Schlegel, Schleiermacher, Arndt, Kleist, Immermann and, very significantly, the mood of the Feuerbach-Wagner episode ("das Junge Deutschland"), now almost forgotten in our approved texts. "I am the fate which prevents the world from crumbling to pieces.... We are to experience a great revolution which will compass at one stroke what reason must for ever fail to accomplish" (Tieck). "Industry and utility are the angels of death who, with flaming sword, prevent man from his return to paradise" (Fr. Schlegel). "To become even more what I am is my only aim; every act of my life is a special phase of this one aim....I shun nothing; all is the same to

[5] After so much water has run beneath the bridges, it is interesting to recall that, making every allowance for the provocation of Heyse's *de haute en bas* attitude toward French *esprit*, so able a man as A. Réville fails to catch the implications of this novel. His extensive review is curiously left-handed. Cf. "Un roman philosophique en Allemagne," *Revue des Deux Mondes*, Vol. 107, pp. 316-48.

[6] Samuel Butler, *The Way of All Flesh*, Chap. XII.

me" (Schleiermacher). "Our scholars are ambitious busybodies heaping up endless material, unable to use it....and our whole age is impotent" (Arndt). "What I am going to tell you may perhaps cost you your life: but I must, I must do it" (Kleist). "With stormlike rapidity the present age is moving on toward dry mechanicalism" (Immermann). "We fight, not for human rights, but for the divine right of man" (Heine). "Out of his own innermost nature he pronounced to himself....the Delphian oracle: he, God and priest in one, divine man, himself in the whole, the whole in him" (Wagner, in his Feuerbach period). The doublets in Nietzsche are close enough to be called weird; the Kleist apostrophe, for instance, recurs in so many words, and as an actual incident too!

Nevertheless, the *belle âme* and the *schöne Seele* of romantic achievement have given place to the *freie Geist* of *die Wiederkunft des Gleichen*. Another phase of cosmopolitanism has ousted that of Goethe, who was a "good European" as of the Europe *before* the French Revolution. The Titanism of revolt returns, tremendous now. Hence, to adduce a few differences at random, we do not ask with Werther, What do you mean by "it is good" or "it is bad." We have been swept "beyond good and bad." We see, like Obermann, that our comrades are sunk in hypocrisy, prejudice, superstition and convention. But we know why now and, scruples being put to flight, have no need to shrink into our several shells. Again. we are made acutely aware of the superiority of our powers to our conditions, but the incongruity, so far from rendering us wretched with Benjamin Constant, proffers us our real opportunity. One is no longer so feeble, so devoid of virility, as to quail before society after the example of Adolphe. Thus, freer than ever, Nietzsche can revert lightly to the minor Titanism of *René*. "All my life long I have had a wide-spread and yet insignificantly small world before my eyes, and at my side a yawning abyss." But the greater Titan scorns to hesitate here. He abolishes the small world, abyss and all, because he fathoms the future and forecasts the completion promised by it. Once more, with Fr. Schlegel and Novalis the call was for "a mythology which can be to us what the mythology of the Greeks and Romans was to them." Why, this very mythology has issued from Nietzsche's brain, ready for every business. In a word, he himself justifies his own greatness. He has surpassed romantic self-identification with nature, the eighteenth-century phase, and resignation before the force of things as they are, the nineteenth-

century phase. The human mission as revealed in himself suffices him. Titanism has come full circle when it dismisses the dilemma of "all or nothing" by seizing upon "all" confident that, even under finite forms, a final end can be compassed. Nor Napoleonic France nor Imperial Germany contrive to "blot out the national colors of neighboring countries, in the complacent persuasion that they themselves have a monopoly of civilization." For, Nietzsche has conquered by tearing the secret from "secret infinitude," thanks to his improvement upon the weapon forged by evolution.

If the prospect did not lead so far afield, it would be interesting to trace his affinities, quite marked, with the Catholic or, as some futile folk call it, "reactionary" element in romanticism. For, the "unalienable rights" of revolutionary *risorgimento* were transmuted by the idea of development into the doctrine that an individual can be little more than a vehicle of the collective wisdom of the race, particularly *his* race. In any case, who is he that he should dare set up his petty private opinion against the norms of all good men, proven by trial over generations? Possibly, Nietzsche felt the force of this appeal with crystal-clear intuition. His peculiar cast of mind enraged him against "the greatest folly of the greatest number," his periphrasis for history. But there is another factor, also far removed from the drab sobrieties of technical philosophy, which ought to be emphasized, the more that so little attention has been bestowed upon it in Anglo-American circles. I mean the influence of the Renaissance. Mr. Salter deals with it incidentally.

Enormous difference admitted, Nietzsche is, like Rabelais, a great *baroque*. Homeless in his home world, he proved a poor citizen, as Niebuhr says of Plato. Accordingly, with more than a reminiscence of the greatest Greek, he bethought him of the "universal man," especially of the "unique man," the characteristic ideal of humanism—the individual who is strong enough to exhibit complete contempt for customary values and yet to survive whole. Here lies the reason for his immeasurable denunciation of Christianity. Seen by his essentially unhistorical mind, "Christianity" had destroyed the society productive of this type. He did not realize that the culprit was the Counter-Reformation. Hence, too, his bitterness toward feudalized scholarship. An elective affinity of Pico della Mirandola, he would "live forever, not in the schools of the word-catchers, but in the circle of the wise." By the same sign, the Germans are "barbarians," synonyms for "all that is filthy." Over

against their esteems Nietzsche sets Renaissance *nobilità*—"the capacity for moral and intellectual eminence." He would be the Apollo in the "Parnassus" of Raphael; nay, something more, the first man! Did not God speak to Adam, saying: "Medium te mundi possui ut circumspiceres inde commodius quidquid est in mundo. Nec te caelestem neque terrenum, neque mortalem neque immortalem fecimus, ut tui ipsius quasi arbitrarius honorariusque plastes et fictor in quam malueris tute formam effingas. Poteris in inferiora quae sunt bruta degenerare, poteris in superiora quae sunt divina ex tui animi sententia regenerari."[7] The field was free, all things were possible, and Adam was born again—in the person of Zarathustra! Becoming a complete being, Nietzsche in his completeness rediscovered, and read with new inwardness the apothegm of *Stupor Mundi* (Frederick II), "Three have deceived the world, to wit, Moses, Christ and Mohammed." It is all inconceivably subjective after the manner of romanticism, inconceivably secular after the manner of the Renaissance, both seen in the light of a century when discovery of the natural order, absorbing man's best brain, had sapped philosophy. Egoism there is, colossal egoism, if you choose to take it that way; but history does not repeat itself, and the cynicism is merely instrumental to the evocation of a devastating conscience. An individual has gained the completest of triumphs, by serving himself universal.[8] Inheriting the mail-shirt of Werner von Urslingen, fighting under its motto, "The enemy of God, of pity and of mercy," Nietzsche has "better bettered" the *condottiere* by exercising godlessness, pitilessness and mercilessness toward himself most of all. Finally, this master-stroke of kindly (or was it unkindly?) fate befell him through no fault or merit of his own, but as *the* inevitable manifestation of cosmic necessity. So he thought. No, Nietzsche's philosophizing is germane, not to philosophical *Wissenschaft*, but to the dynamism of a prophetic mystic. In a word, he is significant for philosophy because he compels it to comprehend him.

Ibsen may be the "modern Diderot," Tolstoy the "modern Rousseau"; by comparison Nietzsche is himself, yet of the straight romantic breed. Listen to Beyle's conversation with Byron and, substituting severest self-discipline for a sentimentalism that hurtles toward mawkishness the further it is flung, glimpse the real truth.

[7] Pico's "Oratio de Hominis Dignitate," in his *Commentationes*.

[8] Several seductive problems cluster here. For example, what was Nietzsche's precise relation, if any, to Gobineau?

"But Milord is a romanticist," suggested Beyle. "No: I am myself," Byron replied. Whereupon Beyle, prefiguring our latest "intellectual," rejoined, "You are mine, for you obey the first rule of romanticism." Training with his kind and, more than likely, bigger than others, Nietzsche haunts the frontiers of everything—philosophy, psychology, religion, sociology, politics and so on. No contemptible poet, the coruscations of his volcanic soul crystallize in a prose style which extends the range of the German tongue indefinitely, so much so, that the man *is* the style. Thanks to the groundlings, we have forgotten that Carlyle was the greatest dramatist of the nineteenth century—shades of *A Doll's House*, spooks of *Plays, Pleasant and Unpleasant!* If we cannot place Nietzsche on such lonely eminence, he was at least one of its greatest artists. And this may well serve to remind us yet again of his Platonic affiliations. Let philosophy stand down, duly abashed. Lessing and Rousseau, Herder and Goethe, Carlyle and Ruskin, and, if you seek paradox, even Newman, are his congeners. It were fatuous to attempt comparisons, because the end is not yet. Besides, he has one brother of the spirit, the most significant phenomenon cast up thus far by the United States—Emerson. I strongly suspect that, were one to take America in its direst slough of despond, about 1814, thence to the forces culminating in the Civil War; and the brassy new Empire, of frightful mien in its own eyes, but progressively moth-eaten with unanimist subservience, a most fruitful parallel could be drawn.[9] At least, the implicit "philosophy" might become plain. And I imagine we should not be surprised to find it the subtle, persistent Platonism which has unfailingly inspired men who felt themselves free enough to take elbow-room. The macrocosm, a chaos otherwise, becomes a cosmos—in the soul of the microcosm. Here is the center of immensity. "The one thing in the world, of value, is the active soul." So Emerson. "If there were Gods, how could I endure not to be a God?" So Nietzsche. Thus the prophets possess a "nature" (*Vornehmheit*, akin to Renaissance *nobilità*), as the German romantics called it; and Philosophy must needs hear them, as even Mr.

[9] Note in passing that, just as *Kinder der Welt* is the best introduction to Nietzsche, there is a best introduction to Emerson, though of a very different kind. George Palmer Putnam's *American Facts* (1845), an apology curiously compounded of snarling and fawning, gives the clue to his aversions. He had reason and to spare for assertion of self-dependence. Obfuscation was everywhere. Consider these footprints on the sands of time: Thoreau successful by auto-intoxication, Poe sent to Coventry, Bryant and other tabbies stroked on and from the seats of the mighty.. Small wonder that Emerson gave Nietzsche the lead in recommending war as a cathartic.

Bradley admits.[10] Thanks to this "nature," they call themselves to the company of the elect. As naturally, their pugnacious pathos always betokens an activist philosophical yeast. Setting spiritual and practical freedom by the ears, they are keenly concerned to maintain that a man's "morals" have nothing to do with his—or any—metaphysics. The old, illusory whatever-it-may-be is slashed to bits; the seer heads a revolt of the human spirit. And the value of it? The value of it lies precisely in its relentless pursuit of stupidity by creatures of destiny! "Away with this hurrah of the masses, and let us have the considerate vote of single men spoken on their honor and conscience." Emerson said this once, Nietzsche a thousand times.

As I see it, then, we must approach Nietzsche from some such angle rather than from the objectivities of philosophy. But if so, another generation may well have to pass ere the time will be ripe. Meanwhile, every one who desires to learn what manner of man he actually was, to know how his cyclopean notions rolled, must go to Mr. Salter. I detect no sign of a "post-Nietzschean period in philosophical speculation," rather the reverse—witness Thomas Mann's *Betrachtungen eines Unpolitischen*—but Mr. Salter's withers are unwrung. He has given us the most completely equipped monograph on a single thinker within living American memory.

R. M. WENLEY.

ANN ARBOR.

THE EDUCATION OF HENRY ADAMS.

This book has made an interesting appeal to the American public. It is widely read. It has been numerously reviewed. In fact, one feels that some explanation is in order before the reader is asked to consider anything further. By way of apology and encouragement it is mentioned here that this paper limits its purpose to the philosophy of Henry Adams as expressed in the book and implied in the teaching and method of Adams.

We get a man's philosophy at the end of his career. Hence we proceed backward, beginning with the last chapter in the book. "Nunc Age" is the title. Adams returns to America, the long search for an education ended. As the ship enters New York, Adams standing upon the deck views the city. The appearance of the city violated every canon of art. There was no unity, no

[10] Cf. *Ethical Studies*, p. 181.

form, no beauty. Adams saw chaos and hysteria, a disorderly exhibition of vast, unregulated force. The city seemed the result of an explosion, an upheaval of mad power. Physical expansion beyond the utmost dream on every hand. The center of this power was the Trust, and the Trust illustrated monopoly. Adams looked for the man who had increased with this increase in physical power. He could see no gain in man. "The two thousand years' failure of Christianity roared upward from Broadway, and no Constantine the Great was in sight." Adams saw no gain in ultimate values from the Trust. "They tore society to pieces and trampled it underfoot." Roosevelt was giving battle to the Trust in Washington. Adams journeyed thither. There he found John Hay, his good friend. Roosevelt made no impression upon the Trust. John Hay was one of our great secretaries; but his career was as puzzling to Adams as was the city of New York. Hay represented intelligence, order, high purpose. He had developed an Atlantic policy. Through this policy peace would come to all the nations bordering the Atlantic and remain with them. He was at work upon a similar policy for the Pacific. Against him as crude, raw power stood the Senate. The life of Hay broke against this power and the policy was blocked. Power triumphs over intelligence. Adams saw in the struggle of Hay the same ultimate problem that Plato saw when Athens broke the life of Socrates. Neither man recovered from the experience. Adams closes the chapter with the melancholy reflection that it might be interesting to return one hundred years hence and look again upon the tangle.

In the chapter "Vis Nova" we have the problem that broke Henry Adams. He had lived in Europe and studied its life. He found there the power of the Virgin. This influence had produced an excellent type of man. It also manifested itself in forms of beauty permanent and gracious. Adams yielded to the appeal of the cathedral and the glass in the windows of the cathedrals. It was the Virgin that broke the power of the Empire. Rome knew slavery and the occult as power. But Rome could not digest the power of slavery and in the end was undone by it. Then came the power of the Virgin, deep, subtile, ennobling, expressing itself in the cathedral as visible, permanent beauty. Here man came into relation with ultimate value and his education made progress.

Out of this rich, moving experience Adams crossed the Atlantic to visit the St. Louis Exposition. Here he met a new power, coal.

Coal produced steam and steam produced, not beauty, but force. Adams was unable to find any ultimate value in force that educated. The Exposition was closed on Sunday. The best in a man is associated with Sunday. The exposition had no message for man on Sunday. The cathedrals were never closed. They had wide-open relations to life. Adams was utterly puzzled. He said that his education failed him completely. He saw only chaos in the vast exhibition of force. He preferred the cathedral and returned to Europe.

To enter fully into Henry Adams's difficulty one must consider the teaching in the chapter called "The Problem," in the Degradation of Democratic Dogma. The problem here is the possibility of history. The historians have stood upon the first law of physics, the conservation of energy. Using Lyell and Darwin as interpreters of this law, he sets forth to report the phenomena of man's life as a steady, progressive realization of perfection. A controlling purpose, wise and good, is in these phenomena holding them to the great end. The historian examines the past, the present and the future. Out of this examination he brings a practical formula for the daily, safe conduct of man.

As Adams sees it, this method is not to be tolerated. It is historical scandal. It ignores completely the second law of thermodynamics. This law states the opposite of the law of evolution. Energy is not conserved; it is lost. Nature is not developing. Nature is dying. This discovery was stated by Sadi Carnot in 1824. It was developed by Thompson, Lord Kelvin, Clausius and Helmholtz. "There is at present in the material world a universal tendency to the dissipation of mechanical energy." "Within a finite period of time past, the earth must have been, and within a finite period of time to come, the earth must again be, unfit for the habitation of man as at present constituted." Adams says, "When this young man of twenty-eight thus tossed the universe into the ash-heap, few took him seriously; but after the first gasp of surprise physicists began to give him qualified support which soon became absolute."

Accepting this second law of physics, life shows metaphysical confusion, ultimate defeat. In this utter antagonism, what is the hope for history? Adams, a professional historian, was unable to find himself. He found it impossible to understand history. Nobody has understood death. The only utterance about it so far is to deny it. In the face of the facts and the second law of physics, Adams

admitted that the earth was dying. The sun is steadily decreasing. At one time its diameter was equal to the orbit of Mercury. Plant life reached its maximum in the carboniferous period. Animal life reached its maximum in the miocene period. At the end of these periods the earth faltered under its load. According to Saporta the shrinkage of the sun manifested itself in the cooling of the earth at the poles. These places ceased to support life. The migration began toward the equator. Adams could find no relief in the suggestion that man was not held in the nature-process. He accepted the teaching of evolution. He saw no possible rescue from the whirlpool. Man is in and of the death-struggle. Man dies. Physically man dies. Intellectually man dies. As man is developed, he does not transcend the law. He dies faster. Already he has lost twelve teeth. His jaw-bone is narrower and hence weaker than it should be. Physically the developed man is without value. The training of his intelligence does not avail. The scholar loses the hair from his head, his teeth, and his eyes. The developed woman tends to become sterile and to lose the capacity to nourish her offspring.

Confronted with this condition, Adams resumes his task of formulating a possible plan for history.

The static treatment of history is without foundation or hope. Evolution and the second law of thermodynamics have done for history a revolution as complete as the work of Copernicus did for the Ptolemaic astronomy. The same kind of work must be done for history that was done for nature by Galileo, Kepler and Newton. But these men did not have to consider the second law. The task of the historian is more difficult. Frankly, Adams feels that the historian is out of a job. His occupation, beyond that of nature's stenographer, is gone. In the chapter "A Dynamic Theory of History" Adams presents the case so far as it is possible to do so. Given two equal forces, moving in opposite directions, is a purpose possible? The old static theory with its basket full of facts is absurd. There are no facts. There are forces, currents, and these in deadly grapple, with death getting the better of the struggle. Can we find the law of the struggle? Can apparent facts find a place or function in the world-whirl? The comet of 1824 rushes into the sun, remains within its circle, then wheels about and retires, unmindful of the laws of attraction and unmelted by the heat of the sun. Adams says all known methods of explanation fail before such a phenomenon.

The development of Roman life proceeded steadily until its high point under Diocletian. The achievement looked to be progress. Value had been achieved. Diocletian resigned. The movement stopped, then fell back, then chaos. Is this evolution? Is it anything intelligible? Gibbon wrote volumes to explain the problem. He left it where he found it. Adams sat on the steps of the deserted temple where Gibbon had sat and pondered over the problem. He could find no relief. Rome, by the sacred doctrine of evolution, should have stood. One page of man's life illustrates development; the next page exhibits the death of this progress. There is no history in the sense of a steady realization of perfection. History as a science is impossible. The educating force in Europe is not a supreme European purpose, but the compass, gunpowder, and the microscope. Man has followed these blindly. They have controlled the lines of action.

Adams spent seventy years in the effort to adjust himself, and failed. Education was supposed to prepare him. It did nothing. "If school helped, it was only by re-action." "The passionate hatred of school methods was almost a method in itself." "For success in life as imposed upon him he needed, as afterward appeared, the facile use of only four tools, mathematics, French, German and Spanish. These four tools were necessary to his success in life, but he never controlled any one of them." "Books remained as in the eighteenth century, the source of life." The condition was not improved by four years at Harvard. "Beyond two or three Greek plays, the student got nothing from the ancient languages." "He could not afterward remember to have heard the name of Karl Marx mentioned, or the title of *Kapital*. He was equally ignorant of Auguste Comte. Yet these were the two writers of his time who most influenced its thought." "The entire work of the four years at Harvard could have been easily put into the work of any four months in after-life." "Socially or intellectually the college was for him negative and in some ways mischievous. The most tolerant man in the world could not see good in the lower habits of the students, but the vices were less harmful than the virtues." Having failed to become equipped at Harvard, Adams goes to Germany and enters the University of Berlin. The results were less than at Harvard.

Having failed to secure education at the hands of the university, Adams sought it of the politicians, diplomats, and in travel. He

was in Washington when President Grant announced his cabinet. He went to Washington eager to learn and expecting to support Grant. He says, "To the end of his life, he wondered at the suddenness of the revolution which actually, within five minutes, changed his intended future into an absurdity so laughable as to make him ashamed of it." With diplomacy the case was little better. Gladstone admitted that his view of policy in 1860 was terribly wrong. The war of 1870 was not expected and nobody predicted the outcome. Diplomats appeared to have nothing to teach. They were concerned with "theaters, restaurants, monde, demi-monde, drives, splendor, grandezza." Adams says he learned the little he knew by accident. generally the concept breaking when he was idle or trying for something else. Therefore Adams loved travel. I suppose he would admit that travel gave him social education. It certainly made him a highly cultured man.

The thin confidence left to Adams in current methods of education was destroyed by the career of Clarence King. King was the young man perfectly equipped for a successful life. He had all that American education could give. Yet his end was miserable; his life a palpable failure. John Hay was a great secretary of state. Yet he had to fight the Senate constantly and saw most of his work killed by the Senate.

Perhaps the above statement will serve to set forth that Henry Adams saw a deep problem and was unable to satisfy his intellect. Physically, socially, religiously, intellectually he faced chaos. He never had a sense of world-mastery. He never caught the vision of supreme purpose in ultimate triumph everywhere. Chaos, night, the end is the story.

As said in the beginning, the book has had a wide response from the public. Does this mean that the book interprets the deeper consciousness of American life? Is America to repeat the experience of Europe and give to the world a "Dark Age," a confessed sense of utter failure? Is this the significance of the wild, mad abandon of ultimate principle characterizing so much of life to-day? I do not suppose that the winter season is to be stopped in its approach by criticism or argument; but it is of advantage to see its coming and to prepare for its ice and storm. Adams points clearly to a winter season in civilization, if nothing more. It is in order to attempt to understand the grounds of his prophecy and the method of it.

Adams had a view of knowledge, a method of study, and a philosophy underlying this view and determining his method. Let us consider these in order.

Psychologists are not agreed as to exactly what happens when you know. You look at a bench. You get knowledge. Is there any wood in your knowledge? If there is no wood in your head, and you have knowledge of the wood, which is not wood at all, we are in difficulties at once. Like other men, Adams holds one theory of knowledge and uses a different theory in criticism. Education is learning, getting knowledge. What is it one gets? Adams says, "The young man himself, the subject of education, is a certain form of energy; the object to be gained is economy of force; the training is partly the clearing away of obstacles, partly the direct application of effort. Once acquired, the tools and models may be thrown away." That is, the aim in education is to grow a strong, full man who can put forth effort efficiently.

In criticism Adams uses another theory. Truth is objective. The process of education is to connect the student with this perfect truth. Thus connected, the student will be equipped to master the forces in his life. This is the mechanical view. Truth is as the water at the bottom of the well; man is one hundred feet away: education is the device of the bucket, chain and windlass. When the chain breaks, there is thirst unquenched. The mechanical theory enables one to pass swift, final, infallible judgments. Adams's book abounds in these ultimate judgments. The chain broke. There is nothing to discuss. Nothing escapes the keen analysis of Adams. Adams sought all the education within reach; but when the grapple came, he was without the infallible formula. The fault was in the education. The chain broke. Clarence King was the best educated young man in America. The panic of 1893 ruined his fortune; germs ruined his health; he died in a lonely lodging-house, his education failing to meet every test. Education had no value for Clarence King. Hay and Lodge succeeded, but not through education. Each one married into a wealthy family. Theoretically education should cover the past, the present, the future; actually it is of no value at any point. This conclusion is final for Adams.

This conclusion ignores the view of education stated by Adams. Not a perfect formula, but an efficient man is the aim of education. This view does not require that a man transcend himself. It is enough that he be "a certain form of energy, efficiently putting

forth effort." An educated man need not be always successful; it is enough that he find his place and fill it. Force is negative as well as positive. The nitrogen is good nitrogen when it loses its form and lives as big, green corn. No education, no knowledge can go in advance of concrete, vital things. To be qualified to order a perfect dinner and enjoy it fully is not an adequate training for cooking a similar meal. When Adams says the four years at Harvard were wasted, it is in order to ask for the explanation of Adams. He became an international figure. He wrote a remarkable book. Upon what meat did this young Cæsar feed? If we accept the theory of education stated by Adams, then the fact of Adams as he matured annuls his criticism.

The method of Adams is intellectualistic. That is, he permits no elemental function to feeling. He strives to be pure intelligence. He admits willing, but only as force; and unrationalized force is chaos. Strict intellectualism can never lead beyond itself. Limited to an intellectual analysis the Sophists of Greece could find nothing of value. So of David Hume. The intellectual process is a process of assimilation. It may be compared to the process of digestion. When the dinner is digested, it has ceased to be, as dinner. It has become muscle, nerve, blood, power to do. So it is with knowing. To know is to understand, to master, to assimilate. When a problem is solved it ceases to be a problem; it is now power of the intelligence solving it. Mastery, strength, insight come to the intelligence solving it. The truth in the problem has been assimilated. This knowledge that is understanding is centered not in the object, nor the subject, but in concepts. The concept is individual, and yet more than individual. The individual gets it. It is his, and yet he can share it with others and lose nothing by giving it. How the concept breaks into the consciousness is not yet described. James says, "By a process too well known to need description." If Professor James knew, he stood alone in the world. We get concepts by study, by loafing, by dreaming, by toil and by the aid of teachers. The ancients called it a process of vision that occurred on mountain tops. The Greeks called it *eureka*. The act is individual always. When it comes, the result is a state of identity between the student and his knowledge. It ceases to exist over against him. It is his discovery, his theory, his truth. He is now an authority, a master. Adams says his concepts came by accident. He found his first musical satisfaction in this way. I think this is

the experience of all students. I know a student who worked ten years to get a concept of law. It burst upon him one morning when he was trying to do something else. The process of understanding is as vital to the spiritual life as eating bread is to the physical life. One cannot recall the assimilated elements in either process. The act is an analysis in which the object disappears. What remains is an experience, a growth. This process of growth has vitamines that so far defy analysis. They escape the scientist in his analysis of the simpler forms of life; they are far beyond us in the higher forms of life. Therefore, when Adams says he got nothing from his four years at Harvard, he is like the boy who complained of hunger six hours after he had feasted at a marvelous banquet. His keen hunger is largely the result of the perfect banquet. If the boy had filled himself with fried meat and grease, he would never have cared for another banquet. Adams spent his life searching for more. He gave free rein to his intellect. It was keen, strong, penetrating Its work abounds in charm and sparkle. Nothing escaped it. Like the scientist dissecting a cat, it did a thorough job. Only fragments remained. Love rears the objects that the intellect dissects. Adams permitted no place for the emotions. Therefore he found life empty.

The philosophy of Adams is interesting. He had reached a state of detachment from any creed. His intellectual processes were uncommonly free. He accepted the facts and bowed to the currents as he uncovered them. But Adams did not free himself of the inertia or habit that goes with mental inheritance. Nor could he escape the guna of Greek philosophy. Adams fancied himself so free as to be capable of pure intellectual processes, utterly beyond the control of partiality. He went cordially as far as the first law of physics and the doctrine of evolution made clear. But he was unwilling to go further than was clear. He could see no evolution in the fall of the Roman Empire, and said so frankly. Nobody ever showed the evolution here. With equal sincerity he went with the second law of thermodynamics, the law of decadence. These laws contradicted each other. Adams did his utmost to find a line of advance beyond this stalemate. To the end he stood helpless. The problem appeared to grow. He saw that nature had ceased to do large things. The large animals were extinct. The big mountains are finished incidents. No more wide oceans need be hoped for. Nature is cooling and the sun is decreasing. Nature's only constructive interest appears to be in microbes, the microscopic.

BOOK REVIEWS.

INTERNATIONAL POLITICS. By *C. Delisle Burns.* London: Methuen and Co. Pp. x, 189. Price, 5s. net.

Mr. Delisle Burns has written a very readable description of international politics and indicated the principal problems calling for solution which the contact of cultures and of political and commercial rivalries has produced. Though Mr. Burns gives us a clear account of the facts of the international situation as they will appear to a dispassionate observer, and this is valuable work, there is no serious attempt made to trace the psychological antecedents of existing conditions. That is to say, Mr. Burns makes it obvious that national prejudices are frequently ridiculous, and diplomatic practices fraudulent, but we are not made to understand how it happens that the average good father may become a hypocrite when acting as a state official abroad, or good neighbors show an habitual lack of sympathy toward foreigners. The author, too, has a tendency to see in all national policy the deliberate design of ministers fully conscious of their aims and the consequences of their actions. In spite of these psychological defects Mr. Delisle Burns's book should form a useful introduction to the study of world-problems. (In a second edition the foot-note quotations from French sources will need careful revision.) FRANK WATTS.

WHAT RELIGION IS. By *Bernard Bosanquet.* London: Macmillan and Co., 1920. Pp. xii, 81. Price, 3s. 6d. net.

In this sincere little book Dr. Bosanquet attempts to express with simplicity and directness what appear to him to be the distinguishing marks of a true religion. "Whenever a man is so carried beyond himself," he says, "whether for any other being, or for a cause or for a nation, that his personal fate seems to him as nothing in comparison to the happiness or triumph of the other, there you have the universal basis and structure of religion."

Dr. Bosanquet does not, however, approach his subject in this wide and generous spirit straight away, and consequently those prejudiced readers for whom the traditional terms of Christian theology—sin, salvation, justification by faith, suffering, etc.—have an alien or hostile sound may find it difficult to get beyond the first few pages. To those, however, for whom such terms have a friendly and intimate meaning Dr. Bosanquet will appeal from the start with genuine power. We should have recommended an approach to the subject through the spirit of the last chapter rather than through that of the first, for here we find ourselves at a common meeting-point away from which the non-Christian might be led with greater success through the more uninviting by-ways (where the theologians throng) to the peace which is beyond.

FRANK WATTS.

VOL. XXXI APRIL, 1921 NO. 2

THE MONIST

MENTAL SPACIOUSNESS.

ON the whole, the prevailing opinion in modern philosophy has been that minds are in time but not in space. This belief, to be sure, is held on very different grounds, and it is often denied—again for many reasons. Those who accept it, for example, include M. Bergson who considers space to be illusory and time indefeasibly real, together with the ordinary dualist (and perhaps the ordinary psychologist) who has no doubts about the reality either of time or of space. Those who reject it, on the other hand, include Spinoza who believed that time was only a prop to the imagination although he accepted the full reality of the attribute of extension and completely excluded the attribute of thought from it; and they also include Mr. Bradley and his friends who deny the reality of time and space and, for that mater, of personality itself. It is only in quite recent times, however, that modern philosophers, other than avowed materialists, have maintained, seriously and literally, that minds are spatial as well as temporal.

Now philosophers are accustomed to impute motives to one another, perhaps because manners are relative, perhaps because truth is unmannerly; and so we need not be surprised to find that those who believe that their minds are spatial are apt to twit their opponents with sinister or sentimental designs. The spaciousness of mind, we are told, is the belief of all sensible and unsophisticated men (these adjectives seem to be equivalent for argumentative

purposes); and, consequently, those who deny it are the dupes of their moral prejudices or of their mystical leanings. In a word, they seek a short road to the immortality of the soul by denying to minds, perversely and arbitrarily, the most fundamental property of material things. It would be possible to argue, no doubt, that *even if* minds were unextended, the moral and theological consequences which are frequently drawn from this supposed circumstance are exceedingly disputable in fact. The soul, for example, would not necessarily be immortal (even in the sense of "natural" immortality) simply because it is indivisible; for an indivisible thing might be extinguished although it could not be divided. Moreover, a temporal soul is at least temporally divisible; and Time is the greatest of all dividers. Although these arguments are possible, however, they are less effective than the simple denial that a mind is anything other than a spatial partner in spatial relations. In that case, it is the other party's turn to seek for recondite arguments which inspire but faint conviction. It is possible, to be sure, that a spatial mind might be indivisible and indestructible, since, for aught we can tell, it might be allied with a "spiritual" body (or an aura) in the brain which is impervious to the assaults of gross corruption; but these speculations suggest special pleading.

There is no need to raise these issues, however, or to impute motives. Immortality is not a logical consequence of the immateriality of the soul, and it is not impossible even if the soul were material. As a matter of fact most professing Christians are really Christian materialists, and I do not see why they should not be. They clutch at any straws they can find in the way of physical survival, and they are dissatisfied unless they can find ocular and even photographic evidence of the continuance of a man's wraith. In a word, the speculative belief in the soul's immortality has very little connection with the speculative belief in its

immateriality, and, for the rest, the Christian materialists, if they were frank, could argue their case very easily. If virtue is an excellent thing, virtuous matter, surely, cannot be less excellent. If beauty throbs with deity, so must material beauty. If the universe, transfigured to the eye of faith, is divined to be the bearer of permanent values, it could not bear these values less readily if they were the values of matter. To put the argument otherwise, if only the immaterial can be valuable, then, because there are values, there must certainly be immaterial things. If not, valuable things may be material, and, for that matter, material things may have all the values which Christians discern in the world.

The spaciousness of the mind, however, is simpler and more general than its materiality, and I am asking the reader to consider this simpler problem. Even so, the problem is intricate enough, as recent discussions have shown. A generation ago, the mind's spaciousness would have seemed an intelligible phrase, needing little explanation, and its spaceless existence in time, if a subtler idea, would have seemed readily comprehensible with a very little philosophy. To-day it is different. We are coming, more and more, to put motion, or space-time in the place of space *and* time; and we have come, at long last, to accept Berkeley's distinction of tactual from other spaces with the seriousness which is due to it, both on the part of a physics that is resolutely empirical and on the part of a metaphysics which is enlightened enough to criticize the ready-made speculations of common-sense theory. For these, if for no other, reasons it is becoming immensely more difficult to say with accuracy what must be meant either by a spacious or by a spaceless existence in time.

On the first of these points I shall be brief. We must admit, I think, that the physical world is really a system of motions, a continuum of point-instants in Mr. Alex-

ander's language or an infinite mode of motion-and-rest in Spinoza's. Within this world we elaborate the orders of space and time; and it is likely, for many reasons, that we separate these orders far too sharply in our usual (and, perhaps, even in our scientific) discourse, ascribing to them a fictitious isolation from and independence of one another. On the other hand, we must also admit that these divisions actually exist in nature, and that our beliefs concerning them, at the worst, do not need more than comparatively slight modifications. For example, even if we are wrong in regarding the length, shape and size of empirically (or, for that matter, of ideally) rigid bodies as a piece of immitigable fact irrespective of any set of axes of reference, we are right, none the less, in most of our assertions concerning the standard yard at Greenwich; and if Lorentz and Fitzgerald and Einstein have taught us to accept the possibility of the variations of all lengths in respect of time, these possibilities become critical only when problems of *extrapolation* are in question. Again, granting that our planet and all its creatures are, and are set in, continua of motion, it does not follow that every piece of existence connected with these planetary creatures is itself a motion. Minds might partake in the time which they share with motion without being motions themselves, and this might be the truth even if we *know* time only through observing motion, and even if space without time would be a nonentity. The consequence we are considering would follow only if *every point of space* were temporal in its structure and if *every instant of time*, however occupied, were meaningless in all respects unless space was written clearly on its forehead. In other words, the *general* correlation of space and time, even if it is far more intimate than we commonly suppose, does not involve this special consequence; and so we are at liberty to hold (I think) that there is a very good meaning in the statement that this or that is

extended, and a thoroughly intelligible meaning in the statement that this or that, while unextended, is temporal.

The other point is more directly relevant. Granting that tables are extended, we have to remember that the tables of our common speech can be seen, and touched and heard, upon occasion. When they are seen, they are colored; when they are touched, they are hard; when they are heard, we can guess where the sound comes from. Now, assuming that the table is extended, in what sense is its color, or its hardness, or the sound of it extended? It can be proved, of course, that the spaces presented to vision are not simply identical with the spaces presented to touch, and so that their "common" space, if there is one, is either a construction from them which is not itself included in either or both, or else a contribution of the mind, or else a sort of play-house stage in which both are present and which both appear to fill, although, in fact, each of them occupies different portions of the same area. This type of problem is even more acute in the case of sounds, for although we may invest them with a tag of volume, we do not perceive them to be spread out over an area (for the sound-patterns of certain experiments are not directly perceived in hearing). It is possible, then, that many of the perceptible features of things may occupy portions of an extended volume without themselves being literally extended in any fashion to which we can assign more than a dubious and conjectural meaning; and it may even be true that colors and roughnesses, instead of being extended, are in reality *unextended* properties of extended particles within a surface. If so, the whole surface might appear to be colored or rough because the particles which have these properties are strewn very thickly within it, and the spaciousness of sound might be doubtful because the resonant particles were scattered more sparsely. Mr. Alexander, I think, suggests something of this kind and the reader

will see how often I am thinking of the delightful discussion in his *Space, Time and Deity*, although I do not profess to reproduce either his language or his meaning in detail.

With these explanations, then, we may proceed directly to our problems, and the reader will perhaps agree with me that the heart of the problem is bared in the trite and somewhat colorless formula that the mind is *dynamically* present to the brain, and *cognitively* present wherever the things of which it thinks may happen to be.

This formula, it is plain, assumes provisionally, if not finally, that mind and brain are distinct existences; that the mind can be spatially present, at any rate in its dynamic intercourse, with a part of the world; and, tacitly at least, that the mind can act on the brain (since, otherwise, its dynamic presence would be meaningless). All these assumptions are disputable, and we cannot wholly avoid these disputes. To save time, however, I shall ask the reader not to dismiss these assumptions peremptorily, and to allow that the third of them is true at any rate in the sense that, when the mind is busy, our actions (which the brain controls at least in part) are different from what they would be if the mind were quiescent. If so, we are certainly bound to consider the sense in which the mind may be said to have spatial influence.

We know, of course, that the brain is a spatial thing, extended if anything is extended: and that the experiments which indicate that there is localization of function within the cortex also indicate that this dynamic presence of the mind affects different portions of the brain at different times. The more recent researches of psychologists, however, suggest that we ought to walk exceedingly warily in these affairs. I do not mean, merely, that the first enthusiasm of Ferrier and his friends has given place to the most determined caution, that the crude hypothesis of a

cell for each idea, and association—tracts to connect them, is almost as obsolete in physiology as it is in psychology, or that (as Dr. Jung has recently reminded us in his *Analytic Psychology*) the anatomical museums attached to most of our asylums have proved quite useless for therapeutic purposes. I mean that the whole doctrine of cortical localization may need drastic revision. If Dr. Head and his colleagues are right,[1] the cortex is really concerned with spatio-temporal correlation, and the special senses have their seat in the optic thalamus. If so, the sensory union which is normal perception must involve many portions of the brain in the exercise of its simplest functions; and cortical lesions and the like should be regarded, not as lesions in the place where the mind works in this or the other operation, but as a critical point in the whole nervous circuit which is involved whenever the mind is said to operate in any of these ways.

These perplexities notwithstanding, it is possible to argue, no doubt, that the mind acts somewhere within the brain and spinal cord, and so that it plays its part in a system of strains and stresses which have a definite position like any other field of any other force. Indeed the whole conception of restricted contact at restricted points may be as unnecessary in other departments of causal influence as in this one. On the other hand, the vaguer the connection assigned, the more difficult it becomes to state precisely what the connection is. More particularly, the difference between a spacious mind acting upon a spacious brain, and a spaceless mind doing so, tends to diminish to vanishing point. Indeed, if the mind is admitted to be a distinct existence from the brain, there seems to be no valid argument to prove that the mind itself is spatial, either in a gross obvious sense, or in a cautious subtle sense. The only plausible argument is a fallacy. To the

[1] See e. g., *Brain*, XLI (1918).

unreflective it might seem that anything which acts *at* a point, or *within* an area, must itself be situated, during the time of the action, at that point, or within that area. This idea, however, is only a generalization from our experience of causal transactions in which both partners are spatial. It loses its reasonableness, therefore, when one of the partners is seriously considered to be non-spatial. The idea of a cause is simpler than the idea of a spatial cause, and if a non-spatial thing acts upon a spatial one, what we have is a spatial *effect* upon the spatial thing, and non-spatial *action* on the part of the non-spatial thing.

This conclusion, I think, must stand, unless it can be proved that the mind is not really distinct from the nervous system, but that some form of the identity-hypothesis should be adopted. I shall therefore discuss what seem to me the most important arguments which seek to prove that mind and brain are identical.

It may be argued, then, in the first place, that the mind does precisely the same kind of work as the nervous system, and that this identity of function strongly suggests identity of nature. The work of the nervous system, we are told, is the integration of responses, and the mind has no other office. Bodily response is, firstly, selective, and, secondly, the timely coordination of these selections. Now, it is our nerves, and their appropriate end-organs, that do this work of selecting from the environment. The retina and its nerves react to light and not to sound: the basilar membrane and its neural system of transport do precisely the reverse. These selected stimuli (or, rather, the currents they arouse and continue) are motions of transition which find an outlet in the adaptations of our muscles and glands. They *must* find an outlet, and dare not lose themselves in the void like some Australian rivers. Coordination in the central nervous system simply determines *what* outlet is found and *when* it is found. This is the guiding idea of the

process, and all the facts, we are told, including the facts of mind, fit into it simply and naturally if we examine them without prepossessions. We may trace the hierarchy of these facts from simple reflexes to conceptual thought, passing from the reflexes to subconscious instinct, and thence to conscious instinct and to the inherited and acquired capacities of Styles or Nokes—or Einstein.

Stated in this form, the identity hypothesis has little to commend it except its resolute simplicity. It is useful, indeed, and conformable to the best Greek traditions, to try to define a thing by explaining what it does. Such attempts, however, are only explorations *toward* definition, since different things may often do the same kind of work. If we had good evidence, therefore, that the mind really *is* different from the brain, we should not need to revise our opinion simply because we discovered that frequently it did the same kind of work; and even if we chose to be illogical in this particular we might have the grace to inquire whether the work of the mind really is the same as the work of the brain. In fact, anyone who holds this belief walks by faith and not by sight. He can see, to be sure, that when our minds are directly occupied with the problems of immediate bodily response, they may fairly be said to continue the work of the nervous system, sometimes continuing it better and sometimes worse. At the best, the time of response is judged more nicely, past experience is utilized with a vague suggestion of foresight, and the "all or nothing" principle may be partially suspended in favor of some colorable effigy of economical, graduated exertion. At the worst, we hesitate and are lost, or spoil our action by wondering how the thing is done. But although these similarities of function in this restricted type of mentality are striking enough in themselves they have comparatively little relevance to mind in its infinite faculty. Even if some of our memories and a few of our

expectations could be thrust into this bed of Procrustes, the poet's imagination and the righteous man's endeavors could not; and, although this contrast may not have been evident in the beginnings of mental history, it is well to remember that things have a way of outgrowing their origins and that menials have been known to supplant their masters.

The important question, therefore, is whether we really have evidence that our minds are different from some procession in our nerves; and it is foolish, I think, to deny that, *prima facie*, we have this evidence in the fullest measure, pressed down and running over. True, it may seem extravagant at this hour to maintain, with Descartes, that we know our own minds better than anything else. Most of us, perhaps, know best what interests us most, and many of us are usually interested in other things than our minds. We should not like to be mindlessly connected with those other things, to be sure; for even the least introspective among us has no leanings towards a somnambulist army or an anaesthetised Stock Exchange. Still, many regard the mind as a *sine qua non* which is not very interesting in itself; and we need not credit them with a knowledge or an interest which they do not feel. On the other hand, it is surely most manifest that we are at least acquainted with our own minds, and that we find qualities in them that we cannot observe in other things or in our own brains. Even professors of physiology know their minds better than their brains; and the mass of mankind know nothing of brain and nerves, although they know their own joys and sorrows and conjecturings very well indeed. Our knowledge of these experiences is neither helped nor hindered by any investigations into the seat of the soul, and it makes no odds to us how doctors dispute whether the heart, or the stomach, or the optic thalami, or the frontal lobe of the cortex, or nothing at all, should be regarded as the bearers

of our experience. The identity hypothesis, therefore, so far from being an obvious or simple one, is, on the face of it, the most improbable assumption that anyone could make.

The close alliance between nerves and mind, however, and the strength of the arguments which go to prove that the brain is at least the permanent condition of our intermittent pulses of consciousness, make the identity hypothesis very tempting, and drive philosophers to seek for an indirect proof. The most plausible suggestion in this connection is the view that a man's body (and brain) is what other people can observe of him, while his mind is precisely the same thing, experienced, however, by the man himself. It would be odd, no doubt, if a man's brain from the man's own point of view had a whole world of qualities which cannot be observed by other people; and it would be stranger still if its qualities when privately experienced had not even the faintest analogue of its discoverable properties when it is publicly perceived. For what is observation if it cannot observe things as they are? On the other hand, odd things happen: there are strong grounds for believing that we cannot observe the minds of other people, whereas we can certainly observe their bodies: and if mental properties are supposed to be merely additional to, and not contradictory of, physical ones, there is no absurdity in believing that the facts revealed to these different kinds of observation may have little or nothing in common.

As it seems to me, this way of arguing is more seductive than solid because it is based upon a contrast within experience which does not, in fact, support the identity hypothesis. Whether we have private acquaintance with many parts of our brains or not, we certainly have private acquaintance with many other parts of our bodies. We feel pleasure and thirst and hunger, and no other person can directly observe these bodily facts. In a word, the fact that our organic and kinaesthetic sensations are private,

not public, is the *whole* of the difference between experiencing our own bodily life and observing the bodily life of other people. Now it is clear that organic sensations are logically on the same footing as any other sensations. If I am right in believing that the table is brown because I see it so, I have precisely the same right (and the same duty) to believe that my throat is parched, not merely in the way which a doctor could see, but in the way in which I sense it. And so on any other hypothesis. Organic sensory qualities are spread over the interior of my body as color is spread over the exterior of my table. We have empirical warrent, therefore, for maintaining that organic sensations occupy an area which is identical with the area of the body which others perceive; and we know from experience what the difference is between our bodies from our own point of view and from the point of view of other people. But how do these facts apply to the mind? A sore foot is not a mind, any more than a brown table is, and this contrast of public and private observation does not help the case. If I felt my mind to be within my body I might have a slender justification for the identity hypothesis. Otherwise, what justification is there?

One of the most interesting features of Mr. Alexander's recent discussion of the question is that he makes precisely this claim. The experience of most psychologists, as reflected in their works, is that our minds are not felt to be spatial except in so far as they are felt to be blended with organic sensations in some Cartesian *mélange confus*. Mr. Alexander, however, distinguishes sharply between our mental "enjoyments" (as he calls them) on the one hand, and our organic sensations and bodily properties on the other hand; and yet he argues that these "enjoyments" are spatial and that the identity hypothesis holds.[2]

[2] See *Space, Time and Deity*, especially Book I, Chaps. III, IV, and Book III, Chap. I, A, and IV, B.

If these "enjoyments" were felt as spatial, Mr. Alexander's form of the identity hypothesis would have much in its favor; and, of course, the mind would be spatial. To the objection that two wholly different things cannot be identical unless one at least is transformed, Mr. Alexander replies that the two are not wholly different, and that the one may really "carry" the other. He does not suppose, it is true, that thinking is only a physiological property. On the contrary, he believes that a new property *emerges* when thinking occurs, so that we have neither brain *and* thought, nor thought which is only a mode of brain. Still, when there is thought, the brain, he says, "carries" a new property which, none the less, is really in it, and, because we "enjoy" our thoughts as spatial, we are justified in believing that our thoughts occur within the brain's volume precisely as we are justified in believing that our organic sensations have their place within the physical body. *Where* precisely our thoughts are, we need not seek to know more minutely; and, perhaps, we should not. After all, it is rather foolish to ask whether life is extended, and where precisely it is; and yet no one denies that extended things are alive. So perhaps they may "mind" as well as live.

Mr. Alexander finds that his mental acts are transitions (or motions) which have "direction" severally, and "structure" conjointly. These transitions, however, are not sensations of movement. The assent of judgment, he tells us, must be sharply distinguished from the nod of the head or the closing of the glottis, and, by the same logic, are even more trenchantly divided from the whole path of the nervous current. "Direction," therefore appears not to be direction, and "structure" not to be structure; but Mr. Alexander means, I think, that the pulse of mind is, as it were, a beat of transition epitomising a whole movement in itself; and this beat of transition might "carry" mind

even if it were but the moment of passage at a synapse, as a well-known theory declares.

I must confess that I cannot find this spatial character in my own "enjoyments"; and I am in excellent company. The empirical fact of connection between mind and body (which, in some sense, is indisputable) seems to me to express all the observable data in the case, and this fact of connection may obviously be interpreted in a great many ways. It must be admitted, however, that Mr. Alexander's theory would probably be the simplest and the best if he were right in his view that all thinking is a species of "conation," and if "conation" were simply what he describes.

A conation, Mr. Alexander thinks, is just a movement, the kind of movement which a mind makes. Such a movement is practical when it issues in muscular action, speculative when it stops short of this and is either arrested or else diverted in some other direction, e. g., to the making of words. This contention, however, is surely most disputable and most improbable. Speculation, I think, may continue without any arrest or diversion of action; but, even if were not so, it would not follow that speculation is nothing but these. Again, if the conation really were diverted, one would suppose that it would become a different conation, and thus that the speculation which epitomizes it would become different also. For example, we know very well what it is to pass from fisticuffs to verbal abuse. It is but metaphor to say that verbal abuse is speculative fisticuffs. And yet there is no genuine difference between this metaphor and the other metaphor which states that thinking is an action diverted into word-making. We know that kind of diversion, and we do not identify it with what it is not. Moreover, an arrested conation is in no better case than a diverted one. We know what baulked or inhibited conation is, and we do not identify it with thinking. Indeed, even if these arguments were unavailing,

it would seem, nevertheless, that Mr. Alexander's theory brings him into a very strange harbor. If our thinking were virtual action in the literal sense (i. e., the beginning of an action which we experience in its incipience) we might admit the validity of his interpretation provided that this incipient action were restricted to the places that such action could reach. On Mr. Alexander's theory, however, these incipient conations (which are literally within our heads) *are* our knowledge of the world outside us. They are our direct perception of a nine-year-old Sirius, our direct acquaintance in memory with our college festivals and our childhood's games. According to the theory, therefore, these conations reach the borders of the stellar universe, and they may extend into an earlier century.

It seems incredible that these powers could belong to a movement wholly enclosed within the brain, and it would plainly be far simpler to suppose that the mind, in a certain sense, is dynamically (or at least physically) present wherever it is cognitively present. This theory, in some form or other, has also been mooted very seriously in recent times; and so it calls for comment.

Let us take an anology. When there is no light, things have no color; when light illuminates them, they are colored. Why should we not suppose, in the same way, that things are soulless when the mind passes them by, and that they are conscious when the mind reaches them? It would not be necessary to suppose that consciousness does anything to the things except to reveal them. Things do not reveal themselves simply because they exist, and this new and wonderful quality is a sufficiently large difference for even a mind to make. If, then, we regard the mind as a light playing upon things, there is no difficulty in believing that it is literally present at every point in space where, as we say, it is cognitively present.

The form in which this theory is commonly presented

is somewhat different from the possibility which I have sketched above. The doctrine is usually stated as if it could dispense with consciousness altogether, and as if what we call consciousness were only an aspect of things. Such an interpretation plainly rejects the very analogy on which it climbed. It speaks as if sections of things could be illuminated without any light to illuminate them, or as if "being" and "being revealed" were one and the same. There is little advantage, I think, in considering any theory which has such an aching gap in it, and so I shall deal with this hypothesis in the more plausible form in which I have stated it.

If the mind is really spatial, this theory seems to me to give by far the most promising account of its spaciousness. It seems reasonable to hold that the mind literally inhabits the whole area which is bounded by its perceptual horizon at any given time. When it perceives the sun from the earth, it may be at the sun and at the earth and it may even span the intervening millions of leagues. When, as we say, we are in Dover listening to the guns at Zeebrugge, the truth may be that our minds are in Zeebrugge as well as in Dover; and, perhaps that they stride across the Channel. And so of the other senses. Perhaps, even, it would be possible to maintain that the mind may literally be present at places with which it has only a conceptual acquaintance, although, in that case, there would be little meaning in supposing it to occupy the intervening positions. Indeed, we could scarcely accept this idea unless we supposed that thinking of a thing at the back of our heads (in its visual character) were the same as seeing it before our eyes. Still, peaks may glitter in an expanse which is itself dark; and, similarly, scattered patches in the boundless expanse of the universe may be revealed for a moment while their surroundings may not be revealed. The status of images would present no difficulties on this interpretation, since

images may plausibly be regarded as portions of perceptible things whose surroundings are not perceived or, if the reader prefers, as half-recollections emancipated, for the time being, from the perceived order of space and time.

It would not be impossible to account for, or at least to include, the rôle of the body according to this hypothesis. The body, on the theory, would be perceived or revealed, broadly speaking, like any other physical object; but it would have a peculiar importance among revealed things, and it would very easily come to be regarded as the true and proper habitation of the mind. The horizon of sight or of hearing, to be sure, is indefinitely larger than the horizon of the body, but most of the other external senses cannot stray very far from the body, if indeed, like heat and cold and perhaps touch, they are not restricted to the surface of the epidermis. Now, when we are conscious, we do not always see or hear, and the only external things of which we are constantly aware are the warmth or coolness of the atmosphere and the pressure on our skin. Again, we are constantly aware of our organic sensations, and these, as we have seen, have their place within the body. The body therefore, to use Berkeley's phrase, is a "tunicle of the soul" in a sense in which nothing else is. It is not the soul's only garment, but it is the only constant one. We carry our organic sensations along with us as we move from scene to scene; we interpret our muscular sensations as indications of the position of things; if we see anything, we see it from the place where we feel our limbs. In a word, the place of our bodies is *always* our place, and no other place is *constantly* ours. The very illusions of personal identity bear witness to the same truth. A well-worn garment may seem to be part of *us*; a new one never does; and any abrupt change in the mass of our private "vital" sensations makes us doubt our identity and may even con-

vey us to a madhouse because we think we have become brittle and therefore dare not move.

To be sure, the problem of the difference between cognitive and dynamic presence would still remain, but the sting of it might be drawn. We have no reason to believe that we act upon the sun when we see it—there are very few who have dreamt of this telekinesis—but we have every reason to suppose that we can act upon our bodies, and that these, in their turn, can manipulate things. It is not absurd to conjecture, however, that only certain things respond to the contact of minds (except in the way of revealing themselves), whereas the nerves of the body respond in other ways, and set the muscles working. Selective action of this kind on the part of physical nature is not at all unusual, and if we chose to be fanciful we might even imagine that our minds (within narrow limits) have learned how to make use of the nerves, and have been too lazy, or too stupid, or too indifferent to learn how to affect anything else.

It seems to me, therefore, that this theory gives by far the best description of the place of the mind, if the mind indeed has a place; and, personally, I should accept it without hesitation or reservation if I saw any good reason for believing that the mind is spatial at all.

What I find to be spatial by direct inspection are the colors, sounds and smells which I perceive outside my body, and the toothache, muscular sensations, and the like which I find within it These sensory data are the elements of the perceived spatial world; and we know of no others. It is true that imaged and remembered things, dream spaces and recollected places, are also spatial; but their elements, as has been hinted, are borrowed from the perceived world; and it is not impossible to admit their spatiality, and yet to deny consistently that there is any empirical spatial world other than the world of perception. To speak of the

perceived world, of course, does not imply that this world is exhausted in any one's perception, or that it is opposed in its essence to conceptual space. What is meant is that parts of it are given directly in perception, and the rest pieced together, expanded (and winnowed) by reflection.

While this, I think, is true, it is of course impossible to *demonstrate* that the mind is non-spatial. The arguments which seek to prove this conclusion are, without exception, bad ones. Thus it seems very certain to most of us that we can think of many things (numbers, for instance) which are not themselves spatial; and hence we might rashly conclude that these thoughts, at all events, are non-spatial. That is a fallacy however; for the thoughts might be spatial, although their objects are not, just as thoughts are plainly temporal although their objects need not be. Or, again, we may be warned against confusing between the delight in good literature, let us say, and the "somatic resonance" (or the organic sensations) which normally accompany this delight. This warning is just, for these emotions are not identical with the organic sensations, but, although different, they might still be spatial. Personally, I think they are not; but if any philosopher says that they feel spatial to him, it is impossible to prove to him, on general grounds, that he must be mistaken.

What I have sought to prove is something less than this. My point is that, *unless* we are assured by direct inspection that our minds are spatial in their essence, we have no good reason for supposing so, on the ground of general theory. Indeed I think that the weight of general argument is against the spatiality of the mind, and I shall conclude by giving my reasons for this opinion.

The most distinctive features of the human mind, I think, are its sentiments and its logic. Now the sentiments play upon the whole gamut of the emotions, ringing out a response according to the condition of the thing towards

which the sentiment goes out. To use the stock illustration, the mother is alarmed when the child is in danger, tranquil when it is safe, tender towards it at every time. I cannot see that this relationship of the emotions is spatial in any sense worth the name, and yet it is this very relationship which is the distinctive way in which the emotions of the mind are organized; and I do not see that any adjacence of nerves could give the slightest hint towards an explanation of this relationship. The case of logic is even stronger. However illogical from a strict academic standpoint the mass of mankind may be, still, men try to think. Even the Bushmen do, although they cannot count up to ten. And what has space to do with logic? Is there not an impassable gulf between the search for identity of characteristics and any sort of spatial conjunction? Let us suppose, *per impossibile,* that logically correct inferences always follow one set of channels in the brain, and illogical ones another. Suppose, even, that the path of these processes could be mapped out, and that teachers of logic could show the chart to their pupils. Would that *explain,* or help to explain, what logic is, or how it satisfies? There does not seem to be even the rudiments of an explanation on lines such as these.

Those who have attempted in the past to weld psychology and physiology into one have commonly argued as if the whole problem were summed up in the coherence of motions in the brain, of the one part, and the association of ideas, of the other part. It is unnecessary nowadays to show that the association of ideas is only a small part of psychology; but even if association were the whole of psychology, one might venture to ask how the spatial paths in the brain could account for anything in this vain theory, fondly invented, except association by contiguity. If A has been experienced along with B, the revival of A might readily arouse B by mere spatial irradiation into contigu-

ous paths. On the other hand, irradiation of this or any other kind could never teach us to detect similarities of character, or to think according to that fashion. And without similarity, where would association be?

JOHN LAIRD.

BELFAST, IRELAND.

PSYCHOLOGY AS BEHAVIORISM.

I.

A characteristic of the knowledge that is called science is that it is *organized*. A number of disconnected facts, however large, is not a science; though, if the number be very large, the facts will not be altogether disconnected, things being as they are. How much connexion there ought to be if a group of facts is to be called a science, it is impossible to say, partly because there is no precise method of determining degree of connexion, and partly because *accuracy* also is a characteristic of scientific knowledge. Thus, the term science may be applied to "facts" if their accuracy is great though their interconnexion is small, or to "facts" whose interconnexion is great but whose accuracy is doubtful. While accuracy is certainly important, the degree of interconnexion is always of the very greatest theoretical interest. This interconnexion is expressed in principles, and hence, in science, discussion of principles is a highly important task. Its relevance in psychology is especially great at the present time. Any serious attempt to formulate psychological principles or to estimate the adequacy of proposed principles; to organize, for instance, the large number of empirical facts which experimental psychology has collected and is still collecting, or those other facts, bidding fair to be still more numerous, which are being brought to the light of day by psychoanalysis; any such attempt is worthy of consideration.

largely on its own account, that is, because principles are essential to science. But at the present time, the psychologist who possesses a conscience at all metaphysical,—who proceeds at all metaphysically in the sense that he tries obstinately to think clearly and consistently,—tends to wince at formulations of psychological principles which seem to manifest, not merely haste, which is natural enough in so commercial an era, but an almost incredible innocence of metaphysic. The present psychological situation, in brief, is one in which principles of psychology deserve special attention.

II.

By Behaviourism is here understood the theory of the subject matter and methods of psychology which has been expounded most fully by Prof. J. B. Watson. This theory consists essentially of two propositions:

1. The subject matter of psychology is behavior exclusively;

2. Behavior is scientifically explicable without reference to what are commonly called mental facts or processes.

Definitions of Psychology.—Modern definitions tend to say that the subject matter of scientific psychology is mental states, processes or phenomena. Thus, James followed Ladd in defining psychology as the "description and explanation of states of consciousness as such."[1] Ward, it is true, in explanation of what he means by saying that the subject matter of psychology is "individual experience" states that "individual experience" is meant to indicate "above all conative activity or behavior"[2]; but, though this explanation would seem to suggest more than a verbal difference between his definition and that of James, the exposition of the science by the two psychologists makes

[1] E. g., *Text Book*, p. 1.

[2] *Psychological Principles*, p. 28.

it clear that the problems regarded as providing the subject matter of psychology are much the same for both of them, and that the differences in their definitions are largely verbal. We need to be told, no doubt, that "individual experience" is intended to mean "above all, conative activity or behavior"; but, equally, we need to be told why instinctive behavior should monopolize a considerable section of a work devoted to the investigation of "states of consciousness as such." Again, some years ago, McDougall stated that psychology might be *best and most comprehensively defined* as the positive science of the conduct of living creatures.[3] But he presently discussed, as psychological questions, the attributes of sensation and feeling tone of images; showing, at least, that his definition did not comprehend the whole of the subject matter of the science, while his general exposition indicated this subject matter to be much the same for him as for James and for Ward, notwithstanding the special direction of his attention to certain problems.

The fact is that definitions of psychology are generally framed so as to emphasize some neglected problem or method, and that no definition yet offered of the subject matter of the science suggests, in a natural way, and without further explanations, the variety of problems the science includes. This is not said in criticism but stated as a fact. It suggests that the actual subject matter of psychology is a number of problems, which can be enumerated one by one, but which present sufficient diversity to make a brief and precise definition of the science extremely difficult, if not, in the logical sense of definition, impossible. It is thus to be expected that verbal definitions of the subject matter of psychology should be inadequate. If they begin by emphasizing consciousness, they will find it difficult, in the end, to include conduct; and if they begin by empha-

[3] *Physiological Psychology*, p. 1.

sizing conduct, they will find it difficult, in the end to include states of consciousness.

The Behaviorist Definition.—The behaviorist definition endeavors to attain adequacy by elimination: it restricts the scope of the science, and excludes certain traditional problems. For when the behaviorist defines the subject matter of psychology as behavior, he does not intend this to be interpreted to mean much the same as is meant by James or Ward in their definitions. When he says behavior, he *means* behavior and *nothing but* behavior. "The time seems to have come" says Professor Watson, "when psychology must discard all reference to consciousness." (*Behavior*, p. 7). Again: "It is possible to write a psychology . . . and never to use the terms consciousness, mental states, mind, content, will, imagery and the like" (*ibid*, p. 9.). This can be done "naturally and conveniently" in terms of behavior. The behaviorist maintains that he does not know what such terms as perception, sensation, image and feeling, mean.

He knows, however, what is meant by behavior. This is the "total striped and unstriped muscular and glandular changes, which follow upon a given stimulus."[4] The stimulus need not originate in the space external to the body, for muscular and glandular changes within the body may themselves act as stimuli to further muscular and glandular changes. But, however caused, these "reactions" are identical with "behavior," and make up the subject matter of psychology (*Psychol. Rev.* 1917, p. 336).

Although this conception seems to restrict the field of psychology in a somewhat startling manner, it leaves it sufficiently large to allow for active research. The behaviorist begins with the child as soon as it is born,—or, more accurately, as soon as breathing is established. At this

[4] Watson's *Psychology*, p. 14.

stage, he attempts to determine what reaction tendencies are *instinctive*: for example, whether the new-born infant possesses innately the neuro-muscular coordinations required for swimming. A small bath of water at body temperature is held in readiness, and (when breathing is established) the infant is slowly lowered into it supported on its back by the experimenter's hands. When this experiment was performed, the particular infant who acted as subject manifested violent signs of fear but no coordinated swimming movements.[5] Clearly numerous experiments of this sort are conceivable.

The infant is then followed through childhood to adulthood with appropriate experiments at each stage. The behaviorist tries to determine, for instance, what are the reactions of a six-months old infant to living furry animals. It is therefore held by its mother in a well-lighted room and shown successively a white rat, a dog, a cat, a white rabbit, beetles and a snake,—its responses to the various objects being noted and subjected to analysis.[6] Much information about human instincts may be acquired by such experiments. But in addition to innate reaction tendencies there are those that are acquired,—problems of habit or learning; and here the field is very wide.

And the apparent restriction of the scope of psychology is not so great as it would, at first sight, appear to be, because certain problems which it might seem would be excluded, are so modified as to be included. Thus the behaviorist includes all problems connected with the range of sensory stimulation. To determine the *range of visual sensibility*, for instance, is a behaviorist problem. But the subject is never to be allowed to say that he "sees" a light or colour when visual stimuli are directed to his eye. "Ordinarily" says Professor Watson, "we mean when we

[5] Watson's *Psychology*, p. 243.

[6] *Psychol. Rev.* 1917, pp. 343-344.

say that an animal is sensitive to difference in wave-length that such stimuli play a part in the adjustment of the animal to food, shelter, escape from enemies, etc., *i.e., that such stimuli initiate activity in arcs which end in striped muscles.*"[7] And so, in experiments, the visual stimulus is *made* to initiate activity in arcs ending in striped muscles. This is achieved by the creation of a *conditioned reflex.* The subject rests his hand upon an electrode, and, to begin with, whenever visual stimuli well within the range of "visibility" are presented, a shock is given, which causes the subject to move his hand. By the repetition of this process, it soon comes about that, when a light is "seen," the hand is moved in a characteristic manner, even when no shock is simultaneously given. And the experimenter can, at this point, take the movement as a sign that a color or light is "seen" (or that the given stimulus is among those that play a part in the adjustment of the subject to food, shelter, etc.). There is no need in such a procedure to use the troublesome word "saw" (or "see"); there is no need for the subject to speak at all. The experimenter knows that, when the characteristic movement of the hand does not occur, the visual stimulus is outside the range of visibility (provided, of course, that the conditioned reflex has not temporarily broken down through fatigue or some other cause, *and that the subject was attending when the stimulus was given.*)

The behaviorist, then, whatever be his difficulties, is not likely to suffer from lack of problems to investigate. Further, his problems are psychological problems, for they are of the types that find a place in standard expositions of the science; if these were appropriately called psychological before, there can be no reason to deny them that title now. Further still, there can be no real objection to the behaviorist applying the term psychology to these problems exclusively. That, in itself, might be a matter of taste and

[7] Watson's *Behavior*, p. 354.

convenience in the use of words, and all that it seems reasonable to say is that the current and traditional usage of psychology is different from this.

But the complication is not simply verbal. Professor Watson says, no doubt, that his conception of psychology excludes many problems with which psychology has been historically concerned;[8] that he does not know what such terms as image, feeling and will mean, and that he can get along quite well without these terms. But he does not mean that he is dividing to conquer; that the excluded problems are genuine enough and that the discarded terms have genuine reality as their meanings; that he has not adequate time, or perhaps interest, to investigate these problems, and so will limit his field. He is not like the artist who says "My work is Art," or the scientist who says (to the artist) "My work is Science." It is rather as though the artist said to the scientist: "There is no such thing as science." For the behaviorist denies the existence of any mental reality. It is not easy to say what is the relation of his position to the later views of James or to the view of the American new-realists; but it is not difficult to determine what the position is in itself. It becomes unambiguous in the form that the only phenomena which could be called mental are muscular and glandular changes. What is to be said of this theory?

III.

Among the phenomena commonly called mental are images and feelings, and these may be used to illustrate an argument which can be applied equally well to *all* "mental" phenomena. The behaviorist must say either that images and feelings do not occur at all, or that, occurring, they are identical with muscular or glandular changes. Now the empirical evidence for the occurrence of images and

[8] *Psychol. Rev.*, 1917, p. 336.

feelings is final. If the behaviorist raises a doubt, the answer is that this evidence is as convincing as the evidence for the occurrence of muscular and glandular changes We observe the one sort of phenomena as assuredly as we do the other. Taking the *occurrence* of images and feelings, then, as beyond doubt, the behaviorist's position must be that these are identical with muscular or glandular changes.

Against this view, the evidence is also conclusive. And this evidence is again of the type admitted, though not discussed, by the behaviorist: it is observation. We need not consider here how much is involved in observation,—for instance, to what extent it requires judgment. It may be taken and used here as it is taken and used by the behaviorist. Muscle movement, for instance, is something that the behaviorist *observes*. He "sees" it when someone crooks his finger or swings a racket. It is important that the behaviorist bases his position upon observation, and that he does not mean, for instance, by a muscular change, certain spatial changes in the relationships of certain ultimate constituents of matter. No: the muscular or glandular change is a straightforward sort of thing. We can observe both it and its effects.

We have thus to compare what we observe when we say we observe behavior with what we observe when we say we are aware of images or feelings, and to ask whether what we observe in the one case is identical with the object of our observation in the other. The answer is most positively that the two are *not* identical. It is *as clear* that a muscular or glandular change is not an image or a feeling *as* that a muscular movement is not a glandular change. The evidence is of precisely the same sort in the two cases. We perceive in both cases that the objects under comparison are different. There is no more reason to say that an image or feeling is identical with a muscular or

glandular change than there is to say that the two latter are identical; and there is *at least as much* reason for denying identity in the one case as in the other. Of course, if our judgments of difference are all false; if tables are identical with chairs and anything is identical with anything else; then images and feelings may be identical with muscular or glandular changes. But we must surely accept our experience of difference as valid until it is demonstrated to be invalid; and the point is that here is a judgment of difference that has not been shown to be invalid.

The same argument applies to all the phenomena currently recognized as mental. The question does not here arise whether images and feelings are *conditioned by* glandular or muscular changes: our question concerns their identity.

IV.

In one instance the behaviorist has attempted *to demonstrate* identity between a phenomenon traditionally regarded as mental, and behavior as defined by himself. This mental phenomenon is thinking. The behaviorist is forced to consider thinking in detail because of the phenomena of delayed reaction. Whenever a response follows relatively immediately upon a stimulus, it is plausible to say that the "sufficient" explanation of the response is this stimulus. But response and stimulus are sometimes separated by considerable intervals of time during which thinking "goes on." It is necessary for the behaviorist to reduce this intermediate activity of thought to muscular and glandular changes.

The evidence adduced to show that thought is identical with certain behavior, as above defined, is of two sorts. (1) The first attempts to show that, when we think silently, movements of the speech muscles occur. The experimental work of the behaviorists in this connection is of consider-

able interest, and will, eventually, in all likelihood, prove still more interesting; but its value as evidence is exactly nil. *In the first place,* the experimenters have had to admit that in some cases of silent thinking, present experimental technique has been inadequate to indicate any muscle movements of the speech mechanism. To this it has been said that present apparatus is faulty and that further refinement of method should give better results, which is true enough; also, that when the apparatus did not show muscular movements during silent thinking in the *speech* mechanism, it was possible that the thinking was then being carried on by movements of *other* muscles in the body. For while the speech muscles are the ones most generally involved in thought, others are not excluded from functioning similarly, and it is, in a way, accidental that thought is constituted by movements of the speech muscles. All which, being so largely supposition, is valueless as evidence. *And secondly,* nothing whatever as to the identity of thought and behavior would be proved even if it were established that muscular changes in the speech mechanism *always* occurred during silent thought. It might simply be a case of concomitance, like a man and his shadow.

Behaviorism admits the weakness of the above line of evidence, and attempts another. (2) This second sort of evidence consists of an attempted reconstruction of the first processes of thinking in the child. Such reconstructions as this are usually not convincing, though the present case is not so bad as those that concern primitive man; but putting this aside, we may consider the present case on its merits.

The general theory is that thinking consists in the fact that certain behavior, *generally* movements of the speech muscles, *operates as a substitute* for other behavior. Thus, the man who excogitates a new aeroplane engine is doing, primarily with his speech muscles, what he could do equally

responses, (*a*) arm, leg and trunk movements to the sight of the ball, (*b*) speech muscle movements necessary to say "ball" in response to that word as spoken by the nurse. Hence, the child presently makes both responses to the mere sight of the ball: when it sees the ball, it moves its arms, legs and trunk suitably, and at the same time says "ball."

It may be remarked in passing that all this appears to find a perfectly satisfactory and straightforward explanation in terms of association. Not that the behaviorist denies this; but why does he say that no animal save man has reached this stage? It is certainly true, at any rate, that conditioned reflexes can be produced in lower animals.

4. The essential fact in the fourth stage is that many instances occur in which the early arm and leg responses to specific stimuli are frustrated: for instance, the ball is on a shelf and cannot therefore be grasped, or rolled along the floor. Two responses have been established to the sight of the ball, the arm, leg and trunk movements, and the word "ball": when one is frustrated only the other occurs. Hence, in many instances the uttered names of objects are the only responses made to them.

5. The fifth stage, not clearly distinguishable from the fourth, seems to consist of the results of numerous particular cases such as that indicated in the fourth stage. The greater frequency with which the uttered word response to objects occurs, tends to establish that response to the exclusion of others. Note broadly what has happened. Movements of the speech muscles have been "substituted" for move-

ments of arm, leg and trunk muscles, and thinking, identical with this substitution, has begun.

6. The final stage in the development is the occurrence of the word without the stimulus of the ball. But this presents no difficulty. Many objects have been seen along with the ball, and by association the sight of any one of these may excite the response,—spoken word "ball." The stimulus may even be intra-organic. As the network of associations is rapidly woven by early experience, it is soon possible for any one of a multitude of stimuli to give rise to word responses.

And thus we have reached "true language habits," *that is,* thought. Presently, the vocal gives way to subvocal thinking, owing to demands of the social environment; the movements of the speech muscles become more refined, and are modified variously, so that words are not now *uttered* in thinking. But nothing new in principle is involved in the subvocal use of the complicated structure of language as we know it.

Any plausibility this theory possesses is due to two factors; its emphasis upon the muscular movements *connected with the uttering of words*, and its assertion that we have, in thinking, essentially a "substitution" of certain muscle movements for others.

Concerning the first of these points, the recognized actual close connection between words and normal thinking is here a cause of some confusion; but the behaviorist maintains that the essence of the matter is the *substitution* and *not* the particular muscles involved. It is not necessary that the substituted muscle movements should be movements of the speech muscles.[11] Any other muscles will

[11] *Cf. Behavior*, p. 325. (The reference to *"bodily language" habits*).

do as well, provided only that there is muscle movement substitution generated by conditioned reflexes. Where does this lead us? Let us, in a perfectly legitimate way, trace the development of early thinking in a hypothetical case in which the substituted muscles are *not* those of the speech mechanism. We shall have six stages, as before.

1. As the speech muscle movements are to be excluded from this process, we shall not begin with the vocal non-language habits but with others. Let us suppose that at a very early date in its life, an infant acquires the habit of withdrawing its right foot on the application to it of an electric shock. We begin, that is to say, with stimulus and response, as Professor Watson does, the difference being simply that our response and stimulus are different from his,—chiefly in the fact that responding muscles are different. (The one case considered may be taken as representative of a whole class of similar cases).

2. In the second stage, the child has acquired a number of habits involving the exercise of arms, legs and trunk. Let us suppose that one of these is the withdrawal of the left foot when touched by a cold object.

3. This step is very important. The nurse, observing the child to withdraw its left foot upon its being subjected to a cold stimulus, decides to give the right foot an electric shock whenever a cold stimulus is applied to the left. This is exactly similar to the situation in which the nurse, when she sees the child make a characteristic response to the sight of the ball, says "ball." And, in each case, the nurse's procedure provides a stimulus to the infant. In Professor Watson's case, the child says "ball": in

the present case, it withdraws its right foot. Here, to begin with, there are two stimuli, (*a*) cold stimulus to left foot, (*b*) electric stimulus to right foot; and two responses, (*a*) withdrawal of left foot, (*b*) withdrawal of right foot. Hence, the child presently makes both responses when the electric stimulus is alone applied. That is, as response to the electric stimulus applied to the right foot, the child now withdraws *both* feet; just as it comes both to say "ball" and make appropriate arm, leg and trunk movements at the mere sight of the ball. *A conditioned reflex has been established.*

4. The essential fact in this stage is the frustration of one of the two responses. Let us suppose the infant's right leg becomes paralyzed: this would correspond to the case in which, in Professor Watson's account, appropriate responses are prevented because, for instance, the ball is on a shelf out of reach What happens now when the electric shock is applied to the right foot? *The child withdraws its left foot only.*

5. This stage will be constituted by the results of many particular processes in the organism similar in principle to that described (in which one movement has been substituted for another), thus giving us many instances of *thought.*

6. The final stage is the withdrawal of the left foot at times when the electric stimulus is *not* applied to the right foot. This presents no difficulty. Many objects have been seen at times when the electric shock was given and the left foot withdrawn; and now the sight of any one of these, by associative connections, may cause the withdrawal of the left foot.

The process just outlined contains all the stages of Professor Watson's process, and the laws by which it develops are identical with the laws by which his process develops. The *only* difference is that the particular muscles involved are different. Hence, the behaviorist must admit either that his account of thinking is inaccurate (since he maintains that the speech muscles are not essential to thinking), or that any phenomenon of the kind just described is a case of thinking.

The second alternative cannot be accepted. The reason is briefly this. We are acquainted with thinking, experiencing it as directly as we ever experience muscle movement; and when we compare what we are acquainted with as thought with what we are acquainted with as muscle-movement substitution, we see that the two are ***not*** identical. They are no more identical than a muscular movement of the right forearm flexor is identical with a muscular movement of the left thigh abductor. The evidence is of the same kind in the two cases,—direct experience. And, let it be said emphatically, it is entirely unnecessary to know everything or even much about thought in order to justify this argument. We may know that red is different from green and not another thing about either. It is psychologically false to suppose that knowledge of difference based upon immediate experience involves any other knowledge.

This brings us to the second reason for any plausibility in the behaviorist's theory of thinking. This, it was said, consisted in the behaviorist's use of the term "substitution" to indicate the essence of his theory. Now, precisely what does the behaviorist mean by muscle movement *substitution?* I may substitute a movement of my right hand for a movement of my left hand in putting on my hat: in short, whenever any purpose realized through the activity of certain muscles comes to be, or happens to be, realized

through the activity of other muscles, we may speak of muscle movement substitution. But according to the behaviorist, substitution occurs when, for instance, I *think* of putting on my hat. Nevertheless, when the speech muscle movements associated with (or constitutive of) this thought occur alone, my hat does not get on to my head. Evidently, this sense of substitution is not intended. And, in fact, there is only one sense of substitution which can be legitimately intended by the behaviorist, and this is that which indicates *simply* the phenomena of *conditioned reflex*. Substitution of this sort, however, is *not* the substitution which is actually involved in thinking, and which may be expressed, briefly, as the use of words (or other material) as signs. We know that the behaviorist's theory is wrong because we know that the latter sort of substitution is *not* muscle movement substitution,—however closely muscle movement substitution may be associated with certain forms of it.

VI.

The second proposition of which behaviorism was said (Sect. II) to consist is that behavior is scientifically explicable without reference to what are commonly called mental facts or processes. If the behaviorist were right in his attempted reduction of mental life to muscular and glandular changes, he would of course be right in his second proposition; but this second proposition might, logically, be true, even though his attempted reduction were a failure,—as it is. His position would then approximate to psycho-physical parallelism, and the question would be what new evidence in support of this theory, the behaviorist advances.

It may be said at once that the behaviorist brings forward no evidence in support of the theory that behavior is explicable without reference to mental life, except such

as he adduces in support of his position that there is no mental life. Indeed, his second proposition is a corollary to his first. His admission that thinking, in his sense, affects behavior means simply that he inserts certain not very easily observable physiological links in a physico-physiological chain. His first proposition leads him to suppose that the chain has no links that are not either physical or physiological; but he offers no positive evidence that this is so. We may therefore say that the behaviorist has left the body-mind problem exactly where it was.

Two remarks, however, are relevant here. First, we need some criterion of an *adequate* explanation of any given conduct. In the absence of such a criterion, it is easy to offer inadequate as adequate explanations, on the one hand, and to give over-adequate explanations on the other. It would seem to be desirable strictly to limit explanatory facts, in this connection, to those facts from which specific behavior *can be inferred*. In theory this may seem easily possible; but practice here falls far behind the logical ideal. If the behaviorist admits this conception of an adequate explanation, and maintains that he is simply endeavoring to show that the adequate explanation of behavior is physical stimulus plus behavior, we have only to say this: submit the evidence, but do not rely upon *hypothetical* physiological links in the causal chain. Where the links are hypothetical, their nature can hardly be beyond doubt.

Secondly, a good deal of interest attaches to the behaviorist's attempt at a mechanical explanation of the acquisition of motor habits by animals.[12] This is sufficiently interesting on its own account, although whether it has been successful is doubtful. But it is also interesting because of its wider significance. It would certainly be highly interesting if, in a certain case in which the interaction

[12] *Cf.* Watson's *Behavior*, Ch. VII.

hypothesis has been deemed almost inevitable, it should turn out that this hypothesis is not necessary. If the behaviorist can establish that, he will have made a notable contribution to the principles of psychological explanation.

VII.

There remains one further question. The behaviorist is ready to admit that his theory is not established; indeed, he is generally modest concerning *the evidence* for it, and states that he is accepting it *as an assumption,* though a highly reasonable assumption. In face of this position, the obvious question arises: why accept *at all* as true what you do not positively know to be true? In life, no doubt, we must often act on probabilities; but in science the situation is somewhat different. The behaviorist seems to say in answer: I do not make this assumption merely to satisfy my need for believing something, nor for any *practical* reason whatever. It is, on the contrary, accepted merely as a *scientific hypothesis*: behaviorism, in short, is a *hypothesis.*

Now the great respectability of hypothesis in science may lead to the acceptance of this answer without much thought. Hence, the actual situation is likely to cause some surprise when it is realized what it is. It is, in fact, this: there is not the slightest *scientific* reason for making the hypothesis. There is not one of the many very interesting problems with which the behaviorist has concerned himself that could not have been investigated by a scientist who was an interactionist. For instance, it is not necessary to assume behaviorism in order to investigate the extent and character of the muscular and glandular reactions which accompany mental activity, the instinctive neuro-muscular coordinations of an infant, the range of visual sensibility; nor, indeed, for any other *scientific* purpose. If the behaviorist were however to argue that the meaning he attaches

to the statement that "behaviorism is a hypothesis only" is that "behaviorism is *probably true,*" the answer must be: (1) that the first and fundamental proposition of behaviorism is clearly false; (2) that, concerning its second proposition, the truth or falsity of which may be considered undetermined, behaviorism has adduced no evidence to render it probable.

VIII.

The behaviorist may say (1) that he means merely that *he* is going to investigate behavior, as defined by himself, and will call his investigations psychological. Such a position gives rise to no controversy of a scientific character. Or he may say (2) that all currently accepted mental phenomena are identical with behavior. Such a position is definitely erroneous. Finally, he may say (3) that he will accept, *as hypothesis*, the view that behavior is explicable without reference to any phenomena currently recognized as mental. To which the reply is: there is no *scientific* reason for adopting this hypothesis.

B. MUSCIO.

CAMBRIDGE, ENGLAND.

THE ELEMENTS OF CROCE'S AESTHETIC—A CRITICISM.

I have endeavored to show in a previous article[1] that a good deal of confusion attends Croce's presentation of logical principles. The distinctive characteristics of sensation concepts and thought are by no means definitely expressed, and the functions assigned to each at different phases in the course of experience are contradictory; while his classification of concepts is both logically invalid and untrue to actual facts. But Croce's whole work aims at forming a more or less complete philosophic system whose main divisions are essentially interconnected; it is therefore quite legitimate to consider his theories of aesthetic as these are affected by the inadequacy of his *Logic*; and although this reverses his own order of treatment, still he has himself united the two provinces so closely that the inversion is not material.

1. I shall consider first his twofold division of knowledge, together with the theory of intuition, sensation and concepts.

Sensation (in the *Logic*) is for Croce essentially cognitive[2]; a view which fully accords with his division of knowledge into the two familiar forms, intuitive and logical; and since nothing is more important in philosophic speculation than the primary definitions, his development of this dichot-

[1] *Journal of Philosophy*. XVII, 17.

[2] "Sensation must be conceived as something cognitive, as a cognitive act." *Logic*, p. 3.

omy demands most careful consideration. Its full expression takes the following form:—Knowledge either (*a*) is obtained through the imagination; is of the individual; of individual things; and productive of images; or (*b*) is obtained through intellect; is of the universal; of relations between things; and productive of concepts.[3] This parallelism plainly implies that our knowledge of relations is obtained only through the intellect; an implication of the highest importance in view of later developments.

From this standpoint Croce next proceeds to emphasize the value and complete independence of intuitive knowledge, which, contrary to the generally accepted theory which subordinates it to logical knowledge, develops and persists without any direct support from concepts. For this view, as is well known, many weighty arguments have been advanced by various writers; but none, I think, have ever approached Croce's in feebleness and irrelevancy He cites specific instances of intuitions which, he maintains, are thus wholly free from conceptual elements;—"the outline of a country; a musical motive; the words of a lyric."[4] Surely no illustrations could more inadequately serve his purpose; for, being intuitions, they are necessarily the result of that form of knowledge which he has called intuitive; while all relations, on the other hand, must arise (with concepts) from logical knowledge. It at once follows therefore that from the objects of intuitive knowledge in question relations must be completely absent; but how can this be for a moment maintained? Relations, and extremely complex relations, are of the very being of a map, a melody, a poem; in the one case exact and involved spatial relations, in the others delicately balanced temporal, tonal and rhythmic; so much so indeed that all would serve equally well to

[3] *Aesthetic*, p. 1.

[4] *Ibid.*, p. 3. *Cf.* p. 14—"the contour of Sicily"; and contrast the much vaguer instances (p. 7) of "intuitions without space and time—a tint of sky and of sentiment."

support Green's theory of the relational character of reality; for the slightest relational disturbance is amply sufficient to destroy or at least distort their truth and beauty.

It is in fact very remarkable that such a position should be assumed by a writer who, like Croce, is here primarily concerned with Art rather than with knowledge. For it is surely a perfectly obvious truth that artistic mastery (whether this takes the form of talent or of genius) consists essentially in the power of divining and expressing true relations; and the fact that this capacity may appear, to those who do not possess it, to be instinctive or scarcely self-conscious does not alter its essential character. The devastating effects of a half-tone error, of a faulty tempo, of a superfluous foot in scansion, are painfully familiar to every amateur; and the entire course of aesthetic education consists in the struggle to acquire proper control over the relational elements of art. Croce indeed himself recognizes this (p. 16); but as he has already excluded relations, because of their logical origin, from intuitive knowledge, he is now forced to bring them in again; which he does by means of two further distinctions, vital to his whole theory, but here introduced almost as side issues.

The first of these is that the intuitions in question "may be intuitive facts without a shadow of *intellective* relation"; the second is that even if, and when, concepts are present, these "are no longer concepts. They have been concepts, but have now become *simple elements* of intuition."[8] Both these qualifications of his original contention are all important; for the first raises the question—are relations also, like knowledge itself, of two kinds—intellective and (let us say) intuitional? Is it possible for intuitions to include relations which are truly such, although they are not conceptual, not universal, not intellective? Such a distinction

[8] *Ibid.*, p. 3; italics mine; *cf.* p. 36—"knowledge by concepts is knowledge of relations of things, and those things are intuitions."

should surely have been placed with the other bases of the entire theory, rather than brought in as an insignificant allusion without any further elaboration. The second, again, when taken in conjunction with the treatment of concepts in the *Logic*, gives to the whole argument a course so markedly devious as almost to suggest that Croce's contentions arise *ad hoc* from his philosophy, instead of his philosophy proceeding from his reasoning. For we find in the *Logic* that concepts are expressly the work of thought, which derives explicit concepts from representations; the transformation is thoroughgoing, for "the appearance of the concept transfigures the representations on which it arises, making them other than they formerly were";[6] the statement is distinct and emphatic, and in the absence of proof to the contrary, it is but reasonable to suppose that the concepts thus formed will persist as such. Here, however, we find the bare assertion, advanced without any grounds whatever, that when concepts become mingled with intuitions, they thereupon not only cease to be concepts but actually become "simple elements of intuition," to which they were previously diametrically opposed in character. One result then of the intermingling of intuitions and concepts is that the concepts cease to exist altogether, becoming merged in intuition. But when Croce's philosophy demands it, the consequence of this apposition is altogether different; for (p. 52) "the product of intuition placed in contact with the concept" is history! When therefore I draw the map of a country, the concepts and relations concerned in the resultant intuition are either not "intellective," or they have ceased to exist; but when I narrate its history, then the concepts persist as such and contribute their due part to the final result!

Croce supplements this radically faulty analysis of the

[6] *Logic*, pp. 4, 18, 149. "Representation" is, with Croce, equivalent to "intuition."

nature of knowledge and intuition by adducing two further specific instances of the contrast he desires to maintain. *I Promessi Sposi*, then, is intuitional, while Schopenhauer's work is intellective; and the only further explanation given of the difference is, that their purposes and results are different. But this mere citation of a difference which is after all patent to the most casual observation is in no sense an explanation; I account for very little by saying *e. g.* that the difference between machine guns and heavy artillery is that they fire different projectiles. All this is mere philosophical dogmatism, without a single characteristic worthy of serious epistemological argument.

It is equally impossible to reconcile the accompanying description of sensation with the functions that are assigned to it in the *Logic*. There (to repeat) sensation is essentially cognitive, and so operates as a true antecedent to thought itself.[7] But when, in the *Aesthetic*, Croce desires to demarcate intuition from sensation, this becomes "formless matter" producing not cognition but "animality, whatever is brutal and impulsive in man." Even when this matter becomes assimilated by spiritual activity, it is only to become form—it "gives place to concrete form"; so that it is difficult to conceive any sense in which such sensational content can be said to be truly cognitive in any way prior to the distinctive functions of thought: for again (p. 12) sensation "does not change its quality according to its richness or poverty, operating alike in a rudimentary or in a developed organism"; surely its inherent incapacity and worthlessness from the point of view of cognition could not be more forcibly expressed.

Nor is Croce in the slightest degree less dogmatic and more illuminating as to the method by which this defective-

[7] *Logic*, p. 3.

[8] *Aesthetic*, p. 9.

ness of sensation is overcome. The difficulty, as is well known, is one of the most serious that epistemology has to face; indeed it is not, I think, too much to say that it has hitherto proved unsurmountable. This (in my opinion) is but the inevitable result of the general mode of presenting the problem. If we limit ourselves from the outset to sensation as merely subjective mental content, then it must prove wholly impossible to transcend our self-imposed barriers so as to attain knowledge in any true sense of that term.[9] But however that may be, Croce himself makes no attempt whatever to solve the problem he has raised; he is content with the bare assertion that sensation is actually so transformed that knowledge, either intuitive or logical, is achieved. "The spirit does not obtain intuitions otherwise than by making, forming, expressing. Matter, conquered by form, gives place to concrete form. Elaboration of sensation is intuition. That which does not objectify itself in expression is not intuition."[10] All this may of course be quite true; it may indeed, as mysticism, be extremely valuable. But it must be remembered that Croce has chosen to approach his subject from the philosophic standpoint; his aim, on his own showing, is the theoretic analysis of the whole development of knowledge and experience; and from this point of view, the best mysticism is after all but poor philosophy. What his subject demands from him, then, is not the bare assertion that this or that happens; but (what we very rarely obtain) good evidence that it does occur, together with some explanation of why or how it does so.

Consider in this respect *e.g.* that principle so fundamental to his theory of Art—the identity of intuition and expression. Its various statements are all equally emphatic:—"Every true intuition is also expression. It is impossible to distinguish intuition from expression. They

[9] *Cf. Mind.* XXVII, pp. 311....and contrast *Aesthetic*, p. 21.

[10] *Aesthetic*, pp. 9, 12, 13.

are not two, but one."[11] But what is it, let us ask, that is thus expressed? To reply "intuitions" is plainly tautologous, for the two terms are identical; but if on the other hand it is a content of any kind—let us say idea or image or fact or object (Croce cites "intuition of a geometrical figure")—then the question—fundamental in epistemology if not in art—at once arises—How is this content, whatever its nature, formed or obtained? Again we cannot say by intuition, for this denotes "expression"—the expression therefore of some content which must have been previously formed; so that the whole problem of the advance within experience from formless material sensation to some higher content is left in complete obscurity, except for the vague assertions which I have just quoted; and to rest content with the statement that knowledge is obtained either "through the imagination or through intellect" is to bring back into modern philosophy the worst type of scholasticism.

It appears however impossible to ascertain, from the terms employed by Croce, whether intuition denotes a content or an activity. If it is identical with "expression" it must be activity or process; and in consonance with this we find (p. 13) "intuitive activity possesses intuitions." On the other hand we have elsewhere the explicit identification of intuitions with content of various kinds, as in the instances already cited (p. 3); to which must be added (p. 36) "Intuitions are, this river, this lake." The same ambiguity marks the reference to perception on p. 5, where "perception" may mean either the objects cognized, or the consciousness of those objects, which is of course an altogether different thing. So that Croce has here, like several other recent writers, failed to distinguish psychical or spiritual activity from the content or objects with which that activity is concerned; and thus the dilemma arises—If

[11] *Ibid.*, pp. 13, 14.

intuition means content, then it cannot be identical with expression; if on the other hand it denotes merely expressive activity, then the prior formation of the content that is so expressed is left unexplained; as would appear from p. 19, where intuition "is distinguished, as form, from psychic material"; but nothing is said as to how, or why, such material should lend itself to this bestowal of "form"; and this, from every point of view, is the crux of the whole problem.

A further complication follows from Croce's subjectivist position with regard to external or physical reality; for the intuition, as such, lacks the attribute of this form of reality, which must be explicitly conferred upon it by "the application of an abstract concept which is physical, or belonging to external nature"; and this again is not "a truly real reality, (but) a construction or abstraction of the intellect." Obscure as these assertions undeniably are, they certainly confirm Dr. Wildon Carr's opinion that "Croce denies or rejects the reality of the external world." Intuitions then must not only share the obvious defects of all merely subjective content, but must also fall within the scope of the problem of the origin of such content in its relation to "truly real reality."[12]

2. A further, and perhaps (from Croce's particular standpoint) a much more serious result of this rigid identification of intuition and expression, is that it cripples from the outset the author's theory of Art; for artistic ability, even when it becomes genius, loses all qualitative distinction from ordinary experience and becomes merely a question of quantity. Croce seems to revert here to the ante-Kantian position of Hume:—"intuitions are always of sensations and impressions. Art is the expression of impressions."[13] Now Croce has previously asserted (p. 12) that so far as

[12] *Ibid.*, p. 397. *Mind*, XXIX. p. 208 and *loc. cit. ante.*

[13] *Aesthetic*, pp. 21, 22.

sensations are concerned no quantitative change whatever is of the slightest value; "sensation does not change its quality according to its richness or poverty"; its transformation (although it is never explained or described) is there held to be essentially qualitative—"a qualitative formal difference." If then the necessity of such a qualitative change is maintained in the case of sensations, there can be no *prima facie* reasons at least for wholly excluding it from intuitions and for restricting these (as Croce does) to a mere quantitative increase, which, when sensations are concerned, is of no value whatever. It follows therefore that the essential "complexity, complication and difficulty" which are the hallmark of artistry become mere matters of the quantity of intuitions, and further, of what these again are always based on—sensations and impressions. But to such a view there are two serious objections. In the first place it would seem to contradict plain facts of biography and history. Many unquestioned geniuses have passed through strikingly limited experience; their "sensations and impressions" have been, by comparison, of the very scantiest:—Wordsworth, Emerson, Keats, Francis Thompson and the blind seer Milton; not even Shakespeare's "impressions and sensations" account for his unrivalled eminence. And secondly, if genius is thus but a mere quantitative abundance of intuitions, then all work that is truly creative must be impossible; for the artist, no matter how he may juggle with the inner content of his spirit, can but reproduce this in one form or another; he can never see "the light that never was, on sea or land." "No one has ever seen" remarked some one to Turner, "any sunsets like that." "True" replied the painter; "don't you wish we could?"; Corot again ceased painting when full daylight revealed every detail. Croce, however, would seem to agree here with the critic; he would trace every work of art to an ultimate foundation in the mere quantity of actual

sensational and impressional experience, the only other possible factor then being "form,—taking possession of psychic material,—expression," (p. 19); a view which seems however absolutely impotent to account for creative activity,—

> "Such gift allowed to man
> That out of three sounds he frame, not a fourth sound, but a star."

Still pursuing the treatment of content, we find (p. 26) that this can never "possess some determinate or determinable quality....it has no determinable qualities until transformation takes place. We know nothing of its naure." All the diversity of intuitions then depends here not upon content, but on form. As against this however, "it is the matter, the content, that differentiates one of our intuitions from another; form is constant," (p. 9); here differentiation is due wholly to the content, and the two passages appear to be directly contradictory; but the second seems to be supported by the statement—"intuition is distinguished as form from what is felt and suffered";[14] for otherwise feeling itself is wholly lacking in distinguishable qualities, and we are forced to the conclusion that the entire province of feeling is (*a*) neutral and colorless, and (*b*) dependent for its differentiation upon some kind of intuition. But again, since all intuition is essentially expression, it would follow that all feeling and suffering without exception must lend itself to expression; whereas it is a matter of everyday experience that by far the greater part of our feeling is absolutely inexpressible in any way whatever; we can neither adequately describe it nor impart it to another; unless he also actually feels it, he must remain unconscious of it; and all aesthetic intercourse is restricted to the latest formed and most delicate and refined elements

[14] *Aesthetic*, p. 19. It is obvious that both views alike add to the difficulties attending Croce's subjectivist ontology.

of the total feeling content. Once again then Croce's artistic theory comes into direct conflict with the facts of psychology.

A parallel confusion marks the distinction which he draws between philosophy, science and art, when this is compared with the treatment of the point in the *Logic*. There the true philosophic concept, to which science can never attain, is at once concrete and universal. If science attempts to overcome this incompleteness it must "enter the philosophic circle, posit concepts such as the atom, ether, vital force, space. These are true and proper philosophic efforts."[18] This general principle (that a complete science merges in philosophy) may be accepted; but the manner in which Croce applies this truth seems open to serious objections. For in what sense do the concepts cited here (atom etc.) differ from concepts that are purely scientific? Would scientists themselves admit that they possess this exclusively non-scientific character? And if science, in formulating such concepts, becomes philosophy, what concepts remain which the scientist, as such, is permitted to employ? Apparently none; in his distinctive rôle he ceases to exist, and must either content himself with the ideas of ordinary uncritical experience or become a professed philosopher. Further, the concepts here in question, being "true philosophical efforts," must be both universal and concrete; but how can ether and vital force *e.g.*, be regarded either as concrete or as universal in the sense given to those terms by Croce throughout the *Logic?* Surely if these ideas are not abstract that term has no meaning; and when again we turn to p. 397, we find physical or external nature there described as nothing more than an abstract concept, "a construction of the intellect"; so that while "nature" as a whole is abstract, its elements—atom,

[18] *Logic*, pp. 46, 49. *Aesthetic*, p. 50.

ether and so on—are concrete and universal. Space, again, is here truly philosophic; how then, as in the *Logic,* can "triangle" be but an abstract and fictional pseudo-concept? Once more the two standpoints are plainly in absolute contradiction.

3. If finally we consider, as we are quite entitled to do, Croce's philosophy of human experience as a whole, we seem forced to the conclusion that it fails more completely to attain its ostensible object than any of the great historic systems which he so freely criticizes. For after all, wide as are the gaps which these leave in our knowledge, they do in some true sense of the word explain something; great as are the problems which still remain unsolved, we do really comprehend after studying them more than we did before; each thinker, with all his defects, does clear up some aspects of the whole development. But Croce only succeeds in appearing to do this by a *petitio principii* which is none the less actual because he is not himself conscious of it; for I would not be understood to question in the least degree either the sincerity of his attempt or the high value of his work on subjects which are, however, of but subsidiary importance. But the success of his theory of the development of the great provinces of experience is wholly illusory. It really explains in the end nothing whatever; on the contrary, each of the principal stages is, in its turn, employed to account for another, while the final result is then regarded as one chief original source of the very experience from which it itself arose; thus leading to nothing more than a fallacious and theoretically valueless circle of argument.

For although Croce divides knowledge into the two forms intuitive and logical, still he rests both of these on but one and the same ultimate basis—that is on intuition. He does not, like Locke, Kant, and (though less explicitly)

Hegel, trace knowledge back to two different and independent sources, whether this difference be due to reality or merely to our ignorance;[16] and unsatisfactory though this procedure must be, still it does safeguard those who adopt if from the ὕστερον πρότερον which in my opinion vitiates Croce's theory; for as soon as one of these two bases threatens to prove inadequate it always remains possible to take the leap to the other, even though our ideal should be to apply the maxim *natura non facit saltum* to our philosophy; for it is after all decidedly a leap in the dark. Croce, however, posits but one origin for knowledge —intuition, as the following passages plainly show:—"Intuitive knowledge has no need of a master; she does not need to borrow the eyes of others.—Having freed intuitive knowledge from every posterior and external adjunct.... —The aesthetic form is altogether independent and suffices to itself without external support. Expression can exist without the concept, but the concept cannot exist without expression." This priority and independence of intuition are exhibited again in its "purity":—"What can pure intuition mean, but intuition pure of every abstraction, of every conceptual element, neither science, history, nor philosophy?"[17]

Such then is for Croce the single ultimate source of all experience. Below this, it is true, somewhat in the same way as certain phenomena exist below the threshold of consciousness, we find impressions and sensations, sensational material, "mere matter"; but before this can at all enter into experience proper it must be transformed by spiritual or formal activity; although no explanation of this con-

[16] *Cf.* Kant, *Werke*, VIII. 719. "The human understanding is not a faculty of immediate perception, but one of thought, which requires alongside of it, or as its material, a second quite different faculty or receptivity of perception." Hegel's treatment of the question seems to be a matter for argument.

[17] *Aesthetic*, pp. 2, 8, 36, 43, 394.

version is anywhere given. Thus the problem becomes that of accounting for the whole development of experience, in its full diversity, from this sole intuitional origin. What now is Croce's detailed theory of this evolution? It is given partly in the *Aesthetic*, partly in the *Logic*.

(*a*). Turning to the *Logic* we find—but still without any explanation—that concepts are derived from intuitions (representations) by thought; they are of two kinds, which are produced only in the fixed order of true concepts, followed by the pseudo-concepts of both ordinary knowledge and science. "Conceptual fictions *follow* rigorous concepts and presuppose them as their own foundation,"[18] while science "is composed of pseudo-concepts" which, despite their distinctive characters, fall logically within one category with the ideas of everyday life; and the development of science is always in a direction away from the concrete universality of the philosophic concept proper. Certainly both the genesis and the classification here outlined appear highly questionable,[19] but let us accept them and observe the consequences.

For from the interaction between the primal intuitions and these later formed concepts there next arises history, "the product of intuition placed in contact with the concept, (which) presupposes the world of the imagination and the pure philosophical concepts or categories, and produces its judgments or propositions by means of the synthesis of the imagination with the concept." It is essential to note that the active and operative original concept here is that which Croce defines as "pure" and "philosophical," not any lower or simpler form from which philosophic concepts themselves may afterwards arise; on the contrary it is the pure concept itself, without any qualifications, which appears

[18] *Logic*, p. 30; italics mine.

[19] Cf. *Journal Phil., loc. cit.*

and is active at this stage—one of the earliest—in the whole evolution. The term "history" again has a very wide meaning, and the several accounts which are given of its complex formation are by no means of the clearest; it denotes "collections of things that have happened to men and animals, the earth or the stars. The world of history (includes) the reality called physical as well as the spiritual and human. All this world is intuition,"[20]—in spite of the essential activity of the concept from which, as Croce has repeatedly insisted, the intuition as such is wholly free.

(*b*). The next step, following now the *Aesthetic,* is that this historic knowledge, the offspring of intuitions and pure concepts, becomes one of the indispensable bases of Science, the sole other being philosophy. "What there is of truth in the natural sciences is either philosophy or historical fact. What they contain proper to themselves is abstract and arbitrary. Natural sciences presuppose historical material. They submit this material to....abstraction and systematization."[21] And so far, apart from any deficiencies of explanatory theory, there appears to be no fundamental logical defect in the course of the exposition; but with the next stage in the argument—at least so far as the *Aesthetic* is concerned—this certainly seems to arise. For if the historic-scientific knowledge, whose development has just been described, follows a further course it must itself become philosohpy. "When the natural sciences wish to form themselves into perfect sciences, they must enter the philosophical circle, posit concepts anything but natural, (which) are true and proper philosophical efforts."[22]

(*c*). Thus one (if not the sole) final result of experience is philosophy; but philosophy, definitely and specifically in the form of the pure philosophical concept, has al-

[20] *Aesthetic,* pp. 52, 384, 49.
[21] Pp. 50, 384.
[22] P. 50.

ready been postulated as one of the original sources of this experience; thus it appears first at the beginning as one of the origins, and also at the end, and in the same form of the true concept, as the result. The line of argument is certainly complete; but unfortunately it attains its completion only by turning back upon itself so as to form a fallacious circle. Philosophy, as one of the supreme ends of experience, has been accounted for only by being presupposed, with little explanation or none, at the earliest stages of development; it is at once therefore effect and cause, origin and result; and the theory, if it is to be taken as something more than a mere external description of the phenomena, finally explains nothing whatever in any real sense of the word; it merely at the most interprets the development in terms of itself, and thus approaches the sterile identity A=A.

Other considerations, based in part upon Croce's own principles, confirm this conclusion. The final philosophical concept must necessarily be identical with the original because, quite apart from Croce's explicit theory, no other source remains possible. For intuition is, always and essentially, free from concepts; history again, though it may utilize or incorporate them, itself never forms any; it "does not form concepts, does not construct universals or abstractions, but posits intuitions";[23] while science, as distinctively such, obtains its peculiar concepts only by modifying, distorting, or even falsifying the philosophic concept proper, which, it must be remembered, is prior to all other concepts whatever.[24] Again, philosophy, unless it takes the form which is popularly supposed to arise from the thinker's inner consciousness, must obviously rest upon data of some kind—historic, artistic, scientific—indeed on facts

[23] P. 44.

[24] *Logic*. pp. 45, 46, 89, 369.

and principles of all sorts which are either not philosophic at all or at least not explicitly so. It is true that here the *Logic* differs from the *Aesthetic* in that the former excludes the possibility, recognized by the latter, of science merging in philosophy; on the other hand, the *Aesthetic* would on this point seem to agree the better with actual facts, whereas if the standpoint of the *Logic* is correct the consequence must be that one possible source the less remains from which philosophy can arise. But Croce either excludes such material data entirely from the scope of philosophy proper, or he derives them from intuitions together with concepts which themselves are essentially philosophic, and so leaves the problem without any true solution whatever.

4. And in quite another aspect—in relation now to Art and the artist—Croce's *Aesthetic* seems to be strikingly inadequate. I have alluded already to his reduction of the distinction between artistic and other experience to a difference that is never more than quantitative; but he appears further to cut Art completely off both from reality and from thought. For reality, the following passages are sufficiently emphatic: "Art is governed entirely by imagination; its only riches are images. Art does not pronounce (objects) real or imaginary. Art feels and represents them. Nothing more. Art....uses the real, without changing or falsifying it....apprehends it immediately, before it is modified by the concept. The content of the pure intuition cannot be either an abstract or a speculative concept, or a conceptualized representation. Nor can it be a perception (which) implies the application of an abstract conception."[25]

It must be admitted that at first sight the closeness of the connection between Art and reality could not be more

[25] *Aesthetic*, pp. 385, 394, 397.

emphatically expressed than it is here; their interrelation is presented as immediate, without any change or qualification whatever; and it is only when this view, or rather the manner in which it is expressed by Croce, is considered in its bearing upon the nature of human experience as a whole that its shortcomings become apparent. For it seems to invert the actual and indeed the only conceivable mode in which experience develops; so that art in short is brought down to the level of instinct, or of some similarly automatic or non-self-conscious response to external stimuli and internal impulses, instead of ranking with the highest possibilities of spiritual endeavor and attainment. I do not suppose that this result is deliberately the aim of Croce's thought, in spite of his suggestion that art may be the lowest grade of the theoretic spirit.[26] None the less does it seem impossible to place it, as he does, prior to the explicit consciousness of reality, and then to treat this as but an additional or indeed extraneous modification which is wholly due to that Crocean negation of artistic activity, conceptual thought.

On the contrary, if we consider art, as it is only fair to do, at its more advanced stages and in the persons of its best exponents, its sole ultimate aim, its only explicit criterion, self-consciously chosen and pursued, is reality as such. Croce's contention may possibly hold of art in its earliest origins, whether historic or individual; of the simple savage adorning his cave, or of the child who, indifferent to actuality, depicts two eyes in the human profile; but even this can only be because consciousness as a whole is there undifferentiated, permeated by a universal simplicity; not because the pure artistic impulse is strong, and the abstract concept of reality undeveloped. Artistic activity doubtless possesses a quasi-instinctive character; but only a super-

[26] *Loc. cit.*, p. 384.

ficial analysis can regard this as more than an appearance reflecting the observer's own limitations, and so lose sight of the elements of rejection and selection which are indispensable. That reality, then, with which art is in such immediate relation is never prior to the reality of perception, but is rather an advance on this, an elevation and transcendence of it. The artist does not rise to the level of perceptive and rational experience; rather he descends to it, from a mount of transfiguration;[27] he enjoys not a childish dream, but a divine vision. If great art is conscious—explicitly though perhaps not articulately conscious—of any end at all; if it purposely, though not reflectively, chooses and applies any standard whatever; that end and standard is reality. It is not of course, except for a worthless "realism," the pseudo-reality of everyday experience; but this is due not to the peculiarly conceptual character of that experience but to its comparative poverty and lack of intellectual value. It may not, again, be a reality that will stand the test of criticism; deeper insight may prove it to be imperfect or false. But that does not alter the fact that for the true artist the individual standard is reality as he conceives (or even imagines) it. The irresistible driving force which urges him on is the supreme reality of perfection, the sole justification of his effort and the only apology for failure. But Croce makes the artist to be first artist, and then human; his intuitions precede, or are separate from, his perceptions; so that he can turn from his perceptions and fall back on intuitions; which means in effect that he can at will deprive himself of his essential humanity and abandon his natural personality. And to assert that "art is in contact with reality, but does not know that it is so in contact and therefore is not truly

[27] I stand on alien ground.
Surveying awhile the heights I rolled from into the deep.
—*Abt Vogler.*

in contact," is to destroy the grounds of artistic inspiration.[28] It may be hypercritical to point out that an object, as object, cannot be felt; but no object appeals to an artist simply because it is an object, though it may so appeal to an amoeba. Art responds to an object because, paradoxical though it may appear, it is not an object; because it transcends itself, implying something more than what itself appears, and revealing, interpreting, something of the perfect whole that is hidden from the consciousness to which it is an "object." Thus art is always much more than passive feeling and representation; it is rather supremely active, creatively endowing the object that it "uses" with more or less of perfection, with beauty, sublimity, or grace.

Croce profoundly misreads then both the lower human and the higher artistic relation towards reality. His "intuition" is nothing but an abstraction, as are the "sensation" and "thought" of faculty psychology; it can not, more than they, be so isolated and separated from concrete experience as to form the material and basis of aesthetic, prior to and independent of all other elements. The consciousness, though not the explicit concept, of reality is original and primary, a matter of unreflective belief, the uncriticized basis of self and not-self; not even for the philosopher is it a question of applying a concept to some intuitional material which may itself on due occasion be held separately before the mind and as such used, felt or represented. This concept of reality arises from our experience of reality; but Croce reverses this natural order and so makes consciousness of the real the result of the concept.[29]

[28] *Aesthetic*, p. 401. The entire section III may be compared. Contrast again *Abt Vogler*—

> But here is the finger of God, a flash of the will that can,
> Existent behind all laws, that made them and, lo, they are!

[29] "The perception of a physical object as such is not a pure intuition but implies the application of an abstract concept"; *Aesthetic*, p. 397. But obviously

And as with reality, so with thought; the connection indeed is inevitable. Certainly gradations and distinctions become apparent here which before were absent; but to divorce art from thought is to eviscerate it; most notably, perhaps, in poetry, although music, most emotional of all the arts, is also concerned. Profound thought is of the essence of great poetry. The dramatist, depersonalizing himself, depicts and expresses the whole personality—emotions, will and thought—of his characters; any play of Shakespeare's is sufficient proof of this; to question it is to deny history and life. "No man" says Coleridge—at once a competent critic, poet and thinker—the most penetrating critic Britain ever possessed, according to Richard Garnett,—"was ever yet a great poet, without being at the same time a profound philosopher." The poet's thought, certainly, is quite other than that of the professed thinker; it flies and circles where the other plods and burrows. But to separate thought from art as decisively as Croce does—so that even "the distinctions made after reflection have nothing to do with art"[30]—is to deny the organic identity of the larva with the butterfly.

J. E. TURNER.

this is not on all fours with the naive experience—"if I open my eyes and look at a mountain...."; it disregards an enormous advance in critical analysis. *Cf.* James, *Psychology*, ch. 21, and Emerson, *Michael Angelo*.

[30] Aesthetic, p. 32.

PARMENIDES AND AUTHORITY.

THE reason which seems to be given by Parmenides for his theory of being is that any other theory is inconceivable (R. P. 114). The same point of view certainly prevails in Zeno, who relies entirely on formal logic to prove his puzzles. But it is surely not revolutionary to suggest that this procedure involves the working hypothesis that the structure of the universe is like the structure of thought, that to understand the universe is to read into it the characteristics of human reason. That was easy enough when men were ready to admit that knowledge could only maintain between things which were alike, but it is a bit suspicious when men insist that the likeness between subject and object is irrelevant. Yet to argue that a body of propositions about an organic whole must itself be an organic whole, or that a single proposition can never be wholly true because its subject matter is never wholly real, is not very different from arguing, as Plotinus does, that we cannot know evil by any of our organs because our organs are all good, or, as Bergson does, that we cannot know what is dynamic by means of the reason because the reason is static. It is not dissimilar to saying that a body of propositions about unreal facts must be inconsistent or that knowledge of white objects must be white and of black objects black. To be sure if there is no legitimate distinction between thought and its subject-matter, if the two coalesce, these conclusions hold good.

As a matter of fact even the most self-conscious philosophers have read into their subject matter most of their own characteristics. Their tastes have become hypostasized and justified in the most extraordinary manner. The usual reader of philosophical literature hardly appreciates how inconclusive and dogmatic the great works of the philosophic temperament are until he had been enabled to speculate upon them without the books to comfort him and the libraries to bolster up his doubts. Service in the army, for instance, must have shown many students of philosophy that their subject is not so much a guide to life as a picture of life, that much more than lyric poetry is it expressive of individual personality. In the army one meets men who have never seen Burnet's *Early Greek Philosophy* and yet are splendid examples of the perfect Heracleitean or the Parmenidean. Indeed the very kernel of military discipline is the doctrine, "It is," about which there can be no dispute and no question. The army dogma necessitated by the practical needs of war has led military men to believe that in authority you have something—perhaps the only thing —which is substantial. Authority has all the earmarks of sovereignty. It cannot be changed from without, for in its universe it is all-inclusive. It may alter its visible form, but in reality it is immutable. It is blasphemy to seek its origin, for it has neither beginning nor end; it is; "nor will the force of truth suffer aught to arise besides itself from that which is not." If Parmenides had set out to write an accurate description of the authority of a commander-in-chief, he could have done no better than to have written his poem as it now stands.

It is not likely, is it, that people who had never dreamed of Elea should be eleatic, unless there was something in the work of Parmenides which was expressive of a fundamental and widely spread human attitude. One can go

into the expressions of men who have an interest in supporting authority and find eleaticism; one can go into eleaticism and find support for authority. What conclusions is one to draw from this except that metaphysics has a generous element of self-expression in it?

To be sure all philosophers will not admit all this. When they are empirical they maintain that they derive their opinion from facts; when they are rational, they maintain that they derive them from reason. These two weapons are almost omnipotent. They are too powerful, however, for they can justify almost anything.

As early as Plato the Eleatic qualities had become much more than the identification marks of substance, or Space, or being, or whatever it was they are supposed to identify; they had become the signs of great value. Whatever else the ideas were, they were the most worthwhile things in the universe, and it cannot be denied that they were Eleatic; for they were unchangeable (*Phaedo,* 78), "always the same, uncreated and indestructible," never being diminished nor increased (*Tim.*, 51). They were moreover substantial, meaning absolutely sovereign,[1] existing χωρίς. But these were exactly the characteristics which Parmenides had assigned to the subject of his ἐστί or could easily be read into them if one were anxious to find something in the world to which faith could be pinned with reliance. It was these qualities which made the ideas worth knowing and everything valuable (*Phileb.*, 67; *Tim.* 29). It is because both pleasure and the mind are wanting in self sufficiency and in adequacy and perfection that their claims to be the absolute good are disproved. It is because the world is the fairest of creations and that the creator is the best of

[1] See Zeller, *Plato and the Older Academy,* tr. by Alleyne and Goodwin, London, 1888, p. 240, n. 40, where the word "substance" is well defined as "generally anything subsisting for itself, forming no inherent part or attribute of anything else, and having no need of any substratum separate from itself." One can see from this careful definition how practical a meaning there was in the term.

causes that the pattern after which it was made must have been unchangeable and uncreated.

This type of philosophy was characteristic of Greek thinkers. With the possible exception of the philosophies of Empedocles and Democritus, all Greek philosophies, even that of Heracleitus, were a seeking after something permanent, stable, sovereign in its own right. Their *arche* was little more than something like the It of Parmenides. When we read in the histories of philosophy, "Thales said that water was the *arche*," ought we not to revise it to read, "Thales said that the *arche* was water." And this is what Aristotle did say in his account of his predecessors.[2] In the fragments of Anaximander, the similarity is especially interesting. It is complete except that Anaximander made his *arche* infinite, as every one knows, but his reason for doing so, says Aristotle (*Physics*, Bk. III, Ch. IV, 14), was that he believed it made the *arche* divine. He did not prove that the *arche* was infinite, nor did he discover that it was infinite; he wanted it to have all those characteristics which would dignify it in his eyes. Was it a different reason which made the Pythagoreans identify, as the traditional historians tell us, permanent and immutable mathematical relations with the *arche*? Windelband, in his *History of Philosophy*, seems to believe that their eternality, their immutability, their immobility, were sufficient proof of their metaphysical importance. They are the qualities which to a Greek apparently made life worth while, and hence they were the qualities of the *arche*. Who can give any *a priori* reason why the universe must be ultimately one or many, temporal or eternal, permanent or changing? Is not the reason in the long run likely to be that of Parmenides in the Platonic dialog named after him, "If a man fixing his attention on these and like diffi-

[2] But see Benn's *The Greek Philosophers*, London, 1882, Vol. I, p. 7, and Burnet's *Early Greek Philosophy*, 2d ed., London, 1908, p. 48.

culties, does away with ideas of things and will not admit that every individual thing has its own determinate idea which is always one and the same, he will have nothing on which his mind can rest; and so he will utterly destroy the power of reasoning, as you seem to me to have particularly noted" (*Parmen.*, 135).

At this point one is properly met with the objection that Heracleitus at least believed in impermanence. Yet he ordered his flux; the way up and the way down were the same (R. P., 36d); fire, the great destroyer, was itself eternal, "with measures kindling, and measures going out" (R. P., 35; Burnet, p. 148). This is a dynamic philosophy if you will, but it is a corrected dynamism. It may seem relativistic; but it has a fixed reference point. Whether or not Heracleitus's Logos had the connotation of the Stoics'—and they thought it had[3]—the most literal reading of the fragments shows us that the flux was definitely controlled by something from without, which was sovereign and independent of change. "The sun," he says in a well-known passage, "will not overstep his measures; if he does, the Erinyes, the handmaids of Justice, will find him out" (R. P., 39; Burnet, p. 149). The traditional interpretation of Heracleitus would make him out to be a denier of substance and permanence. Yet if the mutilated fragments mean anything, they mean that however dynamic the world is, something there is which directs its flow. No wonder he has been interpreted as the rationalizer of the Mysteries. His fragments might even be taken as tracts to reveal the Reason immanent and concealed in Irrational Nature, a sort of Hellenic Bridgewater Treatise.

It is not hard to see why the Greek philosophers with one or two exceptions sped so unfailingly toward whatever was permanent and reliable. From Thales to Aristotle

[3] So does Benn, *op. cit.*, I, p. 24, and of course Windelband, p. 180. But see Burnet, p. 146, n. 3.

these men were aristocrats. According to tradition Thales besides being an astronomer and geometrician, was the leader in a movement to federalize the Ionian Greeks and a monopolist in food stuffs. Of the semi-mythical Pythagoras we are permitted to believe that his order controlled the political power in Kroton. "The history of the Pythagorean order," says Burnet, "so far as it can be traced, is....the history of an attempt to supersede the State; and its political action is to be explained as a mere incident of that attempt" (*op. cit.*, p. 98).

A definite attitude toward society, and particularly toward that element for whom governments are sometimes said to exist, is first exhibited by Xenophanes. It is an attitude which runs through the later Greek philosophers including Aristotle. Driven out of his birthplace, a wanderer over the face of the earth, he finally found a refuge at Hieron's court. He was certainly no favorite of the people who, he said, honored the athlete at the expense of the philosopher, and who, in their ignorance, projected themselves into the personalities of their gods. The people and popular opinion became the two *bêtes noires* of the Greek thinkers, and when Plato came to write his *Republic*, one sees them merging in the body politic—its worst element.

Heracleitus's life is a sealed book, but he may be credited with royal descent and with having "resigned the nominal position of Basileus in favor of his brother" (Burnet, p. 144). His opinion of his fellow citizens is best expressed in the fragment, "The Ephesians would do well to hang themselves, every grown man of them, and leave the city to beardless lads; for they have cast out Hermadorus, the best man among them, saying, 'We will have none who is best among us; if there be any such, let him go elsewhere and among others'" (R. P., 296; Burnet, 154). His opinion of the people in general is not much

higher. "For what thought or wisdom have they? They follow the poets and take the crowd as their teacher, knowing not that there are many bad and few good. For even the best of them choose one thing above all others, immortal glory among mortals, while most of them are glutted like beasts" (R. P., 31a; Burnet, p. 154).[4] Parmenides, the traditional antithesis of Heracleitus, "like most of the older philosophers, took part in politics; and Speusippos recorded that he legislated for his native city. Others add that the magistrates of Elea made the citizens swear every year to abide by the laws which Parmenides had given them" (Burnet, p. 195). The structure of his poem indicates what he thought of human opinion, although it says little enough about humanity at large.

Empedocles seems to have been more of a popular leader. He lived in troubled times in Sicily and certainly played a part in them. Burnet (pp. 230-231) gives two anecdotes to illustrate his method of dealing with tyrants and oligarchs, and ends this part of his account by saying, "He was offered the kingship which Aristotle tells us he refused. At any rate, we see that Empedocles was the great democratic leader at Akragas in those days, though we have no clear knowledge of what he did." It will be noticed that of all the Greek philosophers, the one who taught that human beings were but the accidental fitting together of odd arms and legs and other organs, and that monsters were as likely to have been produced as normalities, was the one popular leader. His philosophy was from the monistic point of view chaotic, a conglomeration of superstition, myth, observation, imaginative guesses, what not. He is hailed as the great charlatan of ancient times. And yet he is traditionally the great democrat. Benn, for in-

[4] See Burnet's discussion of the three lives, p. 108f, "In this life there are three kinds of men, just as there are three sorts of people who come to the Olympic Games. The lowest class is made up of those who come to buy and sell, and next above them are those who come to compete. Best of all, however, are those who come simply to look on (*θεωρεῖν*)."

stance, says of him, "[His verses'] speculative content exhibits a distinct decline from the height reached by his immediate predecessors. Empedocles betrays a distrust in man's power of discovering truth, almost, although not quite, unknown to them. Too much certainty would be impious. . . . We also miss in him the single-minded devotion to philosophy and their vigorous unity of doctrine. The Acragantine sage was a party leader (in which capacity, to his great credit, he victoriously upheld the popular cause), a rhetorician, an engineer, a physician, and a thaumaturgist. . . . Half-mystic and half-rationalist, he made no attempt to reconcile the two inconsistent sides of his intellectual character" (*op. cit.*, I, p. 27 *et seq.*). He is the one thinker of these times whose work is stubbornly pluralistic, and who seems almost to revel in the variety and diversity of his conception.

When we come to Anaxagoras we are back on familiar ground. We are told that both his and his father's names "have an aristocratic sound, and we may assume they belonged to a family which had won distinction in the State" (Burnet, p. 291). He went, we know, to Athens, not however because "he was attracted thither by anything in the character of the Athenians. No doubt Athens had now become the political center of the Hellenic world; but it had not yet produced a single scientific man" (*ibid.*, p. 294). He seems to have been brought to Athens to adorn the court of Pericles, much as Alcuin was brought to France to adorn that of Charlemagne. He was tried by the Athenians and "for the rest, the most plausible account is that he was got out of prison and sent away by Pericles" (*ibid.*, p. 297). Accounts, however, vary—even to the extent of saying on the one hand that he was sentenced to pay a fine of five talents, to saying on the other hand, that he was sentenced to death (*ibid.*, 297, n. 1).

The later Pythagoreans were no less active in politics

than the founders of the order. "In the fourth century the chief seat of the school is at Taras, and we find the Pythagoreans heading the opposition to Dionysios of Syracuse. It is to this period that Archytas belongs. He was the friend of Plato, and almost realized, if he did not suggest, the ideal of the philosopher king. He ruled Taras for years, and Aristoxenos tells us that he was never defeated in the field of battle" (*ibid.*, 319-320). The same is true of the Eleatics. "Like Parmenides and most other early philosophers, Zeno seems to have played a part in the politics of his native city. Strabo ascribes to him some share of the credit for the good government of Elea.... We hear also that Zeno conspired against a tyrant, whose name is differently given" (*ibid.*, 358). His fellow Parmenidean, Melissus of Samos, was a general in the army which defeated the Athenian fleet in 441-440 B. C. (*ibid.*, 369).

There is no need of going on with this catalog. Scarcely any philosopher has come down to us without some mention of his political connections. We have deliberately taken Burnet's account of these men's lives because it is at once the most sober and the most skeptical. One has only to compare it with Gompertz's to see how little he has drawn upon his personal imagination when it was not a question of omitting something. On the lives of Socrates, Plato and Aristotle it is useless to comment here. The broad lines are known to all, however doubtful the details. Socrates, not having been a metaphysician does not come into our discussion. Plato, after the death of Socrates, certainly felt no love for Athens and the Athenians. If the *Republic* is in any sense of the word a criticism of his city the last half of the eighth book ought to dispel any illusions a man might have about his faith in the people.

"Do you really think, as people are fond of saying, that our youth are corrupted by the Sophists, or that individual

Sophists corrupt them in any degree worth speaking of? Are not the public who say these things the greatest of all Sophists? And do they not educate to perfection alike young and old, men and women, and fashion them after their own heart?....When they meet together, and the world sits down at an assembly, or in a court of law, or a theater, or a camp, or at some other place of resort, and there is a great uproar, and they praise some things that are said or done, and blame other things, equally exaggerating in both, shouting and clapping their hands, and the echo of the rocks and the place in which they are assembled redoubles the sound of the praise or blame—at such a time will not a young man's heart leap within him? Will the influence of education stem the tide of praise or blame, and not rather be carried away in the stream? And will he not have the notions of good and evil which the public in general have—he will do as they do, and as they are, such will he be?" (*Rep.*, 492.)

Such words are not the words of a democrat either in a theory or in practice. Like the expressions of his predecessors which are relevant and extant, they are the words of a social critic with a bias toward aristocracy. All of these men either despise the crowd, like Heracleitus or Xenophanes, or rule it, like Zeno. Empedocles alone seems to have cultivated it. But like the others, he expresses no love for its wildness, no pity for its ignorance. It is an enemy to order, a friend to change, to irrationality. The crowd in turn retaliates with banishments, fines and executions. It is in the relation of the philosophers to society that we find the best clue to their monistic predispositions.

As early as Thales's time Greek civilization was passing through what historians call gloomy straits. The myth of the passing of the Golden Age and the degradation of social values was being verified. The *Polykoiranie,* to which the staunch Odysseus objected with such vehemence was

being realized. The power of the one ruler to whom Zeus had given the scepter had passed into the hands of the nobles. Hesiod had written the record of his depression and Archilochos was adding his bitterness to the literature of this time.

Bury says of this period in his larger history of Greece,[5]

"At first the privileged classes of the aristocratic republics benefited by the increase of commerce; for the nobles were themselves the chief speculators. But the wealth which they acquired by trade undermined their political position. For, in the first place, their influence depended largely on their domains of land; and when industries arose to compete with agriculture, the importance of land necessarily declined. In the second place, wealth introduced a new political standard; and aristocracies resting on birth tended to transform themselves into aristocracies resting on wealth. The proverb 'money makes the man' now came into vogue. As nobility by birth cannot be acquired, whereas wealth can, such a change is always a step in the direction of democracy.

"On the other hand, the poorer freemen at first suffered. How heavily the transition from the old systems of exchange to the use of money bore upon them, we shall find illustrated when we come to the special history of Athens. But their distress and discontent drove them into striving for full political equality, and in many cases they strove with success. The second half of the seventh century (i. e., just before the Milesians) is marked in many parts of Greece by struggles between the classes; and the wiser and better of the nobles began to see the necessity of extending political privileges to their fellow citizens. The centralization in towns, owing to the growth of industries and the declining importance of agriculture, created a new

[5] *History of Greece*, 2 vols., London, 1902, Vol. I, pp. 122 *et seq.*

town population and doubtless helped on the democratic movement."

Even in Sparta, which with its conservative constitution might have been expected to resist innovation, there was a growth of popular strength, and it is suggested that so apparently remote a thing as the introduction of light-armed infantry into the army was a step toward democracy, since it permitted the poor man as well as the rich to equip himself for battle (Bury, I, p. 136). Yet Sparta moved toward suppression of the new voices by running her house in the military manner.

"When Sparta emerges into the full light of history we find her under an iron discipline, which invades every part of a man's life and controls all his actions from his cradle to his death-bed. . . . As a city ruling over a large discontented population of subjects and serfs, she must always be prepared to fight. . . . Though the Helots were not driven by taskmasters, and had the right of acquiring private property, their condition seems to have been hard; at all events, they were always bitterly dissatisfied and ready to rebel, whenever an occasion presented itself. The system of Helotry was a source of danger from the earliest times. . . . and the state of constant military preparation in which the Spartans lived may have been partly due to the consciousness of this peril perpetually at their doors. The *Krypteia* or secret police was instituted. . . . to deal with this danger. Young Spartans were sent into the country and empowered to kill every Helot whom they had reason to regard with suspicion. Closely connected with this system was the remarkable custom that the ephors, in whose hands lay the general control over the Helots, should every year on entering office proclaim war against them. By this device, the youths could slay dangerous Helots without any scruple or fear of the guilt of manslaughter. But notwithstanding these precautions se-

rious revolts broke out again and again." (Bury, I, pp. 137f.)

It was the constitution of this State which Plato admired, living as he did, after the Periclean Age.

With the breakdown of monarchy and the rise of trade, with the consequent appearance of all that is ugly and distressing in commercial life, the loss of the regal manner and personal loyalty, which never fails to be touching even when wasted, the beauty of courts and courtly entertainment, came the new era when men grew uneasy at the sight of so much change. It was at this time when they began to inquire into its cause and to assume without question that beneath it all was some permanent substance on which they could base their hopes. It was as if they were sure that somewhere there was something enduring and reliable if only they could find it. Upon the tablets of Delphi had been engraved the words "Nothing in excess," and we are prone to look upon them as the devout expression of moderate men. And in a sense they were. But uttered in the late seventh century that serene and temperate air is lost, and they sound rather as a warning to a people moving too fast. It was as if they were sounding a halt to the impetuous flight from the old and tried toward the new and unknown.

That men felt the passing of things and the speed of change is evidenced—if not by the poets alone—by the codifying of laws. Throughout the ancient world almost simultaneously the lawgivers arose, Zaleucus, Charondas, Draco, Solon. It is in this movement that Bury sees the beginning of a "long political conflict" (I. p. 154), which resulted here in success for the democrats and here failure, with a predominant instability and swinging from democratic to oligarchical forms of government.

The great advantage of a codified law is of course obvious. Law which is admittedly only the opinion of a magis-

trate varies in justice with the magistrate. We are prone to look upon the modern state's loss of sovereignty and the law's gain of it as a blessing for the governed.[6] A written law, we feel, has lost its arbitrariness. That is indubitably true, but it has also lost its flexibility. A codified law is permanent; it is codified in order to be permanent; and it is improbable that the ancient lawmakers differed very much in their motives from the moderns. The laws of ancient Greece were not noted for their liberality. They were as much an instrument of conservation as of justice. No wonder then that the tyrants, who overthrew them, found an ally in the people. Bury (I, p. 155) seems to think that the people "were not ripe for taking the power into their own hands; and they were glad to entrust it to the man who had helped them to overthrow the hated government of the nobles." But it is hardly likely that any people ever surrendered rights and privileges because of a feeling of immaturity or inability. The desire for autonomy is usually a pretty effective balance for modesty. However unjustified the people may have been in their revolutions, the satisfaction of their demands has always necessitated the amendment of written law.

But such changes were naturally disagreeable to the aristocratic type of mind. One might venture to say that the most unpleasant feature of a tyrant was his friendship for the mob, the arbitrariness of his rule, the lack of consistency in his behavior, rather than his autocracy. But of course a tyrant must be inconsistent if he is to keep his power. For there is nothing consistent and fixed about human life except norms and as Royce pointed out to the satisfaction of Christians and Cynics alike, it requires an eternity to live out the life devoted to their cultivation. Machiavelli, it will be remembered, suggests that "a pru-

[6] Cf. L. Duguit, *Law in the Modern State*, tr. by F. and H. Laski, New York, 1919, especially Ch. VII.

dent lord cannot and ought not to keep his word when such an observance would be contrary to his interests and the occasion of his promise is removed."[7] But to a person who hates caprice and who moves restlessly in an environment which is fluid, such a situation is intolerable and such a rule loathsome. The philosophers of Greece were just such people.

The one Greek philosopher as we have seen above, who said nothing of this, was Empedocles, a demagog and a pluralist whose universe was controlled by love and hate. The one Greek philosopher who had no political connections, as far as we know, Democritus, was an atomist. But their philosophies practically died. The desire for the permanent, the stable, the something substantial and sovereign continued. It survived in all systematic metaphysics. It survived in Plato's ideals which were sovereign, eternal, immutable. It survived in Aristotle's substance. It survived in the Stoic and Epicurean Sages who were alone above change. Throughout the Middle Ages it practically made political science. It survived in the whole seventeenth-century conception of sovereignty and in the eighteenth-century conception of natural law. In the nineteenth century it began to appear as the characteristics of the written legislation and sometimes as the laws of science —"some call it evolution and others call it God."

But as a mere theory, a formal doctrine, like a system of mathematical propositions, it could never have acted as a spur to behavior. It must have been found consonant with someone's tastes, needs, ambitions, aspirations, what you will. To insist that men live the life eternal because they are Christians is not much different from insisting that some ape had to read the *Descent of Man* before the human race could evolve, or that only a thorough drilling in astral physics keeps the planets from colliding.

[7] *Il Principe*, ed. by L. A. Burd, Oxford, 1891, Ch. XVIII, pp. 300 *et seq.*

The tendency toward the permanent, the Eleatic, is a sort of intellectual tropism which can no more be controlled by minds subject to it, than can the heliotropism of certain plants by the plants affected. It exhibits itself in all fields where a norm enters, which will be all fields where human beings come in contact with one another. The Church realized its importance almost in the earliest days of church history. The history of papal supremacy illustrates it perfectly and because most readers have few illusions about the Church, it will undoubtedly be admitted in this case at least that it was not so much a description of facts as the expression of a wish.

From the beginning of the Christian sects to the present day the Church has never existed as a unified body. It has had to fight schism and rebellion from the beginning of time. And yet Catholic doctrine as given in Denzinger's beautiful *Enchiridion* (p. 583) runs something like this. "The Church is a society instituted by Christ the Lord, constituting one body mystical under Christ as a head. It is a supernatural society, perfect and independent, visible and knowable from signs inherent in it, which distinguish it from other religious companies. It is a hierarchy, a monarchy, i. e., constituted under one head having the supreme power: it is therefore one, holy, catholic, apostolic; is necessary to all for salvation....and for the remission of sins; it is perpetual; to it was given the treasury of the merits of Christ....The Church is not divided in two, into carnal and spiritual, or into three branches, Roman-Catholic, Græco-Schismatic, and Anglican."[8]

One could make a perfect parallel between this and Plotinus's World of Ideas. They too are divine in origin, being the thoughts of the second person of his Trinity,

[8] I have omitted Denzinger's page references by which he establishes each point.

the Nous.[9] The World of Ideas is supernatural, existing above the world of sense. But it too is knowable. Just as Pius IX in his epistle "*Tuas libenter*" (*Enchir.* No. 1681) said that Catholics ought to have divine revelation as a guiding star before their eyes when engaged in natural science, so Plotinus teaches that discursive reason is good only up to a certain point; that after that point the soul should know intuitively. The Plotinian world is most decidedly a hierarchy from several points of view, dominated by the One. It has not the religious power of remitting sin for obvious reasons. But it was a unified group of individuals and a catholic group in which schism was as impossible as in the Church.

I do not mean to say that the Church is modelled upon the Plotinian universe. I wish to suggest that it is an expression of similar intellectual needs. From the formulation of the Apostle's Creed to the Fourth Session of the Twentieth Ecumenical Council tradition emphasized this. It emphasized what was eleaticism. It is repeated in creed after creed, "Especially do we believe in the one catholic and apostolic church." The uniqueness of the Church was declared as early as the sixth century when Pelagius II in his epistle to the schismatic bishops of Istria (*Quos ad dilectionem*) referred doubters to Matthew xvi where Peter is given the keys of heaven and ordained to be the rock upon which the Church will be built. But it was actually no more unique than it is now. In fact this letter was occasioned because of the existence of a schism. Yet the Pope was on the way to making it unique by damning and anathematizing those who thought or believed or presumed to teach against its uniqueness (*ibid.*). It was Plato's gesture of forbidding all but geometers to enter the Academy. Plato, however, never went so far as to prove the non-existence

[9] Cf. F. Picavet's *Hypostases Plotiniennes et Trinité Chrétienne*, Paris, 1917.

of non-geometers by excluding them from his society. Of course there was the argument of self-preservation impelling Pelagius as it impelled his successors. So St. Nicholas I defended the Church's immunity and independence in his epistle "*Proposueramus quidem*" to the Emperor Michael, *circa* 865, with the proud words, "Neither by Augustus, nor by all the clergy, nor by kings, nor by the people, shall the judge be judged. . . . *Prima sedes non iudicabitur a quoquam*" (*Enchir.* No. 330). The Church had been given to Peter and there was no higher authority than the Apostolic See. Leo IX in his epistle "*Congratulamur vehementer*" (*Enchir.* No. 347) to Peter, Bishop of Antioch, in 1053, reaffirmed the holiness, catholicity, unity, and truth of the Apostolic Church. By the time of Callixtus II, who was pope from 1119 to 1124, the Ninth Ecumenical Council had decided that so independent, which meant self-dependent, was the Church, that neither prince, nor other layman, no matter how religious, could have a voice in her affairs (*Enchir.* No. 361). She was her own mistress; she was acknowledged to be sovereign.

It is then that she is completely eleatic and it is then that she can be admitted by all to be *semper eadem,* of which Mr. Laski makes so much in his essay on *De Maistre and Bismarck,* a fine example of the same philosophy in two men who were fighting for opposite ends. If that quality of immutability can be proved, it seems to be sufficient to win the obedience of all the members of the Church and an added proof of its authority and sovereignty. The more one studies the bulls, epistles, decretals and other pronouncements in the *Enchiridion* the more one sees the importance of this argument and its central position in the Catholic Faith. It is taken for granted, one might say, that a thing which is not susceptible to change is somehow more valuable than one which is. But one should never forget that the admission of change—an admission which

no pope has granted—involves perhaps the admission that the change is for some end, better or worse than the existing state of affairs, which would be ruinous. But it would be ruinous practically. There is undoubtedly a greater value attached by people to old and lasting things than to new and fleeting things. But has anyone to date been able to explain why? The proof the Church has usually advanced of her own permanence has been John xxi. 15 ff. But the value of that proof is again largely practical. Let us waive the question of whether any proof is any more than that.

The faith in the eleatic nature of the Church was repeated periodically throughout the years, although no new argument was adduced to substantiate it. It was repeated, for instance, by Innocent III in his epistle *"Eius exemplo,"* in 1208, (*Enchir.* No. 423) as one of the admissions prescribed for the recantation of the Waldenses. It was reaffirmed under the same Pope's auspices at the Twelfth Ecumenical Council, 1215 (*Enchir.* No. 430).[10] It was naturally emphasized in the Fourteenth Ecumenical Council which actually succeeded in unifying the East and West for a few years—nor was it renounced when they broke loose later—and was a special article of faith in the profession of faith proposed by Clement IV to the Emperor Michael Palæologus[11] which was adopted at the same council. (*Enchir.* No. 464; cf. 466). It reached a splendid climax when Boniface VIII took it seriously in his Bull *"Unam Sanctam,"* of November 18, 1302.[12] The argument was

[10] But at the same time Walther von der Vogelweide was hymning the same traits in his lord and master, Otto IV. See Luchaire's *Innocent III, la papauté et l'empire*, Paris, 1906, pp. 9f.

[11] See *Enchir.*, p. 201, n. 2.

[12] There is a dispute about this date. See Hefele's *History of the Councils*, French transl. by Dom H. Leclercq, Vol. VI, Paris, 1914, p. 425. The whole Bull is a matter of argument. For its authenticity see Hefele, *ibid.*, p. 427, n. 1; 428, n. 2. Also H. Finke's *Aus den Tagen Bonifaz VIII*, Münster, 1902, Ch. IV, esp. gloss., p. C. There is an apology for it worth seeing in the *Pouvoir du Pape au moyen âge*, Paris, 1845, pp. 569ff, by "M...., Directeur au Séminaire de St. Sulpice."

given a new illumination by this most Hamiltonian of Popes, through setting it in the light of the Old as well as the New Testament. Does not Christ in the *Song of Songs* vi. 9) show the graces of the Church in the glowing words, "My dove, my undefiled is but one; she is the only one of her mother"? "She," says the Pope, represents "the body mystical of which the head is Christ." Furthermore, during the Flood, Noah had but one Arch, which had one helmsman; all else was blotted out. The Church is the seamless garment of the Lord. "Therefore, the one and only Church had one body, one head, and not two heads like a monster; Christ, and Christ's vicar, Peter, and Peter's successor, since the Lord said to Peter himself. 'Feed my sheep' (John xxi. 17). Mine, he said, and mine in general, not singularly these and those; by which he is understood to have taken to himself all sheep."

But at this point the Bull proceeds to derive some practical value out of it all. The Pope takes up the figure of the two swords, the spiritual and the temporal. It is true that there are two, one in the hands of the Church, the other in the hands of the kings and soldiers, *sed ad nutum et patientiam sacerdotis.* Therefore temporal power must submit to spiritual power, the king to the pope—something which Philip the Fair felt was hardly feasible. If the State, furthermore, err, she must be judged by the Church; but if the Church err, she can be judged by God alone.[13] This is undoubtedly the height of the argument, for in it one has the presentation not only of all the eleatic qualities of the Church, but also of the consequences which follow. That which is single, immutable and self-dependent —sovereign—is supreme among societies and authorita-

[13] See Gierke's *Political Theories of the Middle Age*, tr. by F. W. Maitland, Cambridge, 1913, p. 104, n. 9, for valuable material on this argument.

tive. The Church is hardly to be distinguished from the Plotinian One.[14]

None of the popes have explained why that which was eleatic should exact obedience, and one would be hard put to it to give any good reason for it. It is simple to understand why that which wishes to exact obedience and associated values should attempt to prove that it is eleatic. It is the sort of thing one finds in all systems where devout allegiance is demanded from "Thou shalt have no other gods before me" to the days of *"Deutschland über Alles."* It is only proper that a king should deny the existence of other possible kings; or that a supreme God should deny the existence of other gods. Having proved uniqueness, it is an easy step to eternality and to immutability. For all the eleatic qualities are highly useful in preventing the dissipation of power. Dante in his *De Monarchia* (Bk. I, ch. 5)[15] invites attention to the proverbial curse, "May you have a peer in your house," which he poetically interprets as the imposition of an unnatural and hence base situation on the ruler. From it he easily argues for a monarchy. It is a simple matter after that, by an obvious and thoroughly Platonic abstraction, to treat the unity as the important point and the thing unified as unimportant. What this type of mind could do is better illustrated in the ninth chapter. The good son, Dante reasons, should follow his Father. Man is the son of Heaven; therefore he should

[14] Between Boniface VIII and Pius IX little is done about the Eleatic qualities of the Church except the Bull *"Cantate Domino"* of Eugene IV, Feb. 4, 1441, esp. *Enchir.* No. 714; and the Bull of Pius IV *"Iniunctum nobis,"* Nov. 13, 1564, esp. *Enchir.* No. 999.

Under Pius IX, see his encyclical to the bishops of England, Sept. 16, 1864, against the Society for Procuring Christian Unity; his encyclical *"Etsi multa luctuosa,"* Nov. 21, 1873; the allocution *"Luctuosis exagitati,"* March 12, 1887. In Pius IX no one will admit that the arguments are purely theoretical.

His successors have not relinquished the argument. See Leo XIII's encyclical *"Satis cognitum,"* June 29, 1896, and his epistle to Cardinal Gibbons, *"Testem benevolentiae,"* esp. *Enchir.* No. 1975ff, which condemns the idea of an American Church. Add to this Pius X's decretal *"Lamentabili,"* July 3, 1907, directed against the Modernists, esp. Arts. 53, 56, 58, 60, 65, and the matter is brought fairly up to date.

[15] Eng. tr. by Philip H. Wicksteed in the *Temple Classics*, p. 140.

follow Heaven. But all the Heaven is governed by a single motion and a single mover, the *primum mobile* and God. It follows then that mankind should be governed by a single prince as the single mover and a single law as the single motion. Hence there should be one emperor for the whole world.

Dante has a sort of reverence for unity. "Being," he says, "naturally precedes 'oneness' and 'oneness' naturally precedes 'good'; for that which is most existent is most one, and what is most one is most good. And the further anything is removed from the supremely existent the further is it removed from being one, and therefore from being good. Therefore in every kind of things, that is best which is most one. . . . Whence it comes about that 'being one' is seen to be the root of 'being good,' and 'being many' the root of 'being bad'[16]. . . . Hence it may be seen that sinning is naught else than despising and departing from 'unity' and seeking multiplicity. It is clear, then that everything which is good, is good in virtue of consisting in unity" (*Ibid.*, Bk.I, Ch. 15). How easy it is then for him to argue that we must have a unity of wills, and that that can come about only by the domination of one will. which is that of a single prince. "Now," he concludes, "if all the above deductions are sound, which they are, it is necessary for the best disposition of the human race that there should be a monarch in the world, and therefore for the well-being of the world that there should be a monarchy" (*Ibid.*).[17] This type of reasoning is hopelessly medieval, one will say, and yet its imaginative character is even excelled by that of some more recent writers.

Is not Bluntschli's analogy between the state and a

[16] Cf. the Abbé Lantaigne in Anatole France's *L'orme du mail*, pp. 214 *et seq.*

[17] The translator here gives a suggestive reference to the *Paradiso* "in which the whole universe is depicted as a unity."

living organism as fantastic?[18] He says he will not consider the food-hunting and digestive proclivities of animals, nor their power of reproduction. He is content with the following, (*a*) their being a combination of soul and body. (*b*) their forming a whole whose organs have proper functions to fulfill in order to satisfy the vital needs of the body, (*c*) their organic growth. This would be a mere figure of speech, were it not that Bluntschli actually utilizes it as an argument. In his discussion of the relation of Church to State, e.g., the Church is feminine, the State masculine. Hence the Church can have no sovereignty nor would she wish any; she merely wishes to serve God and perform her religious duties—which throws light on the German idea of female character as well as of politics, (*Op. cit.*, p. 23).[19] No one could object to this if it were merely figurative language, but to Bluntschli at any rate the metaphor loses its metaphorical value and is treated literally.

Whatever may have been Dante's reason for his worship of unity, assuming that he had reasons, Bluntschli's could easily be traced to the desire for a German empire. When he begins to argue against the liberation of women (Ch. XX) one sees more than the theorist, one sees the strong father and master in his own house. First, he says, the universal usage of civilized peoples is against equal rights; second, the feminine nature, the sweet virtues of wife and mother, would naturally suffer from the toil and travail of politics; third the virile nature of the State would be corrupted; fourth, the passive moral forces would be

[18] *Lehre vom modernen Staat*, Stuttgart, 1875, Vol. I, p. 19.

[19] Human beings have always looked upon the State as a sort of superhuman being with anthropomorphic traits. Every one knows that it goes back to the *Republic* at least (Bks. III, IV, V), and I venture to suggest that it survives in our constitution with its separation of powers into executive, judiciary, and legislative. I have not been able to find in a hasty reading of Montesquieu made for another purpose an avowal of this analogy, but one who knows faculty psychology would have no trouble in constructing it for himself. The point is that whenever we deal with single things, whenever we handle individuals, we read into them the traits of the human individual. The evolution of Aristotle's Substance into Jehovah is a case in point.

increased, the active weakened, since women are more impressionable than men. Finally, it is one of the provisions of public law "especially among the German people that the wife is made a participant in the political honor and majesty of her husband. There lies therein a recognition of the true indirect relation of the women to the organism of the State, and a worthy substitute for the participation in properly political rights denied them" (p. 234). Again in his theory of the birth of states through *organische Staatstrieb* and *Staatsbewusstsein*, he shows himself much more than the political scientist in his abundant love for the existing order. His theory, much like Dante's is optative rather than indicative.[20]

But we must reserve a discussion of eleatic theories of the state for another moment. Like the excerpts from the papal pronouncements, Bluntschli and Dante simply serve here as examples of the same temperament. The lesson is for the student of philosophy. Philosophy becomes a very curious activity if it is a type of self-expression which consists in reading into the universe either one's own ambitions or one's own actual character. Criticism of philosophy in that case would be more closely akin to criticism of art than of science—a conclusion that a man like Croce would probably welcome. Even Fouillée with his notion that the philosopher seeks "the totality of possible experience"[21] believes that the constructive part of philosophy is essentially artistic. "But," he adds justly enough, "he, [the philosopher], ought never to confuse his divinations with his inductions."

The logic of this type of philosophy is Ribot's *logique des sentiments* rather than his *logique de la raison*. Indeed

[20] See in particular Bk. V, Ch. 4. As Professor Coker rather plaintively remarks, "The value of such a system as an illustrative expedient would depend on its appeal to an imagination of a similar type to that of the artificer's."—*Organismic Theories of the State*, New York, 1910, p. 198.

[21] *L'avenir de la métaphysique*, Paris, 1890, Pt. I, Ch. 5, pp. 79ff.

Ribot believes that that is just what it is. He shows to his own satisfaction that the impulse toward metaphysical imagination is a need of *total explanation.* "It is not an attempt made upon a limited group of phenomena, but a conjecture about the ensemble of things, an aspiration towards completely unified knowledge, a need of final explanation, which for certain spirits is as compelling as any other. This need expresses itself by the creation of a cosmic or human hypothesis, constructed ordinarily according to the type and procedure of scientific hypothesis; but which, radically subjective in its origin, is objective only in appearance. It is a rationalized myth."[22] This is no disproof of metaphysical theories; it is obviously merely an explanation of their genesis. And in his *Logique des Sentiments,* Ribot points out clearly how valuable they are. The logic of feelings may not discover what is known as the truths of the reason, but it effects its end more serviceably and loyally than the reason itself. That is why the law of contradiction has so little place in the formulation of metaphysical systems. I omit a discussion of where it has a place.

GEORGE BOAS.

UNIVERSITY OF CALIFORNIA.

[22] *Essai sur l'imagination créatrice,* Paris, 1900, pp. 210f.

THE REQUIREMENTS OF AN ADEQUATE NATURALISM.*

THE aim of the present investigation is to work out in a systematic fashion the possibility of an adequate naturalism. The time has come for a persistent effort to throw the scientific and philosophical insights of the last generation into an organized whole. If I am not much mistaken, the period of systems is again dawning for philosophy; systems, however, founded upon the careful integration of knowledge with criticism. I would not be surprised if something of finality resulted from the controlled speculation that is now feasible. At no time in the past have the materials and instruments of philosophy been so rich and carefully fashioned. A master mind has an opportunity for interpretative synthesis never before equaled. Surely before long the outline of an adequate world-view will be achieved.

That this coming world-view will be of the nature of an evolutionary naturalism is the thesis of the present work. I shall point out the main problems to be solved and accompany this indication of problems with pretty systematic attempts at their solution. Nowhere shall I willingly resort to ambiguity and equivocation. The problems of philosophy are, to my way of thinking, as specific as those of the special sciences.

*[In the following pages we present the introductory chapter of Mr. Sellars's book on *Evolutionary Naturalism* which the Open Court Publishing Company will bring out in the spring. A few other chapters have appeared in *The Monist* previously. ED.]

Philosophy, like science, is a human achievement, and so rests upon man's capacities. Unlike science, philosophy is forced to consider those capacities and processes which make it possible. It is for this reason that philosophy is necessarily so engrossed with man. Knowledge is a human affair even though that which is known is distinct from the knower. But man is a part of nature, and so these capacities and processes operative in science and philosophy must find their natural explanation. Intelligence must be given its locus and attachments. In other words, science and philosophy are properties of man. To explain them, we must comprehend man's capacities and his place in the world. The final problem of philosophy is to connect the fact and content of knowledge with its conditions. How does knowing occur in the kind of a world that is actually known? Knowing is a fact and must be connected up with the world which the sciences study. Thus a system of philosophy answering this question is the keystone of science.

If this is the case, it is not strange that the possibility of an adequate philosophy waited upon the advance of the special sciences. The biological sciences had to be added to the inorganic sciences before the data for the solution of philosophy's problem approached completeness. The next task was to bring the mental sciences into such close contact with biology that the operations they bore witness to could be seen to be rooted in the organism. Only as this grounding of mind in the body became demonstrably evident did the conditions of a satisfactory philosophy exist. Only then did knowledge become, itself, a natural fact correlatable with all other natural facts. Philosophy is the science which explains the other sciences as human achievements, and thereby completes science.

As we pass from problem to problem, we shall see that

the two great enemies of an evolutionary naturalism are *Platonism* and *Kantianism*. Both deny this self-explanatory character of nature. In a sense, they are both supernaturalistic.

Naturalism stands for the self-sufficiency and intelligibility of the world of space and time. Supernaturalism maintains that this realm is not self-sufficient and that it can be understood only as the field of operation of a spiritual reality outside itself. Historically and logically, naturalism is associated with science, while supernaturalism is the expression of an ethical and religious metaphysics.

The great difficulty confronting naturalism has been the inclusion of man in nature, an inclusion that would do justice to all his distinguishing characteristics. An adequate naturalism must not belittle man in order to press him into some rigid scheme. It must not be *a priori* in its methods and assumptions, but work creatively upon all that can be known about all phases of nature. To-day the naturalist has no excuse for little faith.

We have suggested that supernaturalism is the antithesis of naturalism. If naturalism stresses the self-sufficiency and intelligibility of nature, it can be defeated only by demonstrating the insufficiency of nature. In the past, theological speculation sought to prove the rational need for some primal source beyond nature, for a Necessary Being upon which the contingent world could be grounded. As is well known, the analyses of Hume and Kant gave pause to this direct and assured refutation of naturalism. The three proofs of scholasticism, the cosmological, the ontological and the teleological, were shown to contain assumptions which had small measure of plausibility when critically examined.

But Kant himself suggested a more subtle and indirect way of approach than that of the confident scholasticism

of the precritical period, namely, an appeal to inner convictions or demands of the moral and religious self. But can man's life be divided by a hatchet into two compartments in this easy fashion? *Any semblance of plausibility in such a division was due to the Kantian disposal of the physical world as phenomenal.* Only because nature was more or less illusory could beliefs conflicting with the tide of natural fact retain their prestige.

Now as time passed, ethics and, with it, the theory of values were swept into the current of empirical investigation. English utilitarianism, evolutionism, a broader study of social facts, a more adequate psychology, all these new elements undermined the innate practical reason on its own ground. Psychologically and ethically, man was becoming a part of nature, comprehensible only genetically and biologically. The Kantian dualism between the theoretical and the practical reason no longer sounded relevant to the facts of human life. Man was a very complex whole immersed in and functioning in nature.

The strength of this more subtle attack upon naturalism lay, then, in two things: (1) its denial of physical realism, and (2) its assertion of a contradiction between determinism and empirical freedom. These two motives run through the opposition to naturalism characteristic of the nineteenth century. Idealism maintains, on the one hand, that physical nature is a realm of causal determinism and so contradicts man's freedom; on the other hand, that nature is a construction and not an independent reality. An adequate naturalism must meet both of these contentions. It must demonstrate the validity of physical realism as an epistemology and point out the possibility of reconciling causality with empirical freedom.

Naturalism has been given many meanings in the course of this age-long controversy. Most of these meanings

have been slightly derogatory. The reader must, therefore, be on his guard against the application to the evolutionary naturalism forming to-day of interpretations which were in a measure those of the older, less adequate naturalism of the past. The ethics of modern naturalism, for instance, are by no means those of a crude Darwinism. We belong to a generation which has realized that, while man is an animal, he is not a brute.

Those who attack naturalism usually forget its larger setting and significance. They are not trying to save naturalism from injustice to itself but to destroy it for the greater glory of some view more kindly to supernaturalistic beliefs. Hence, we find naturalism identified without a remainder with naive materialism, positivism, agnosticism, the mechanical view of nature, etc. The weaknesses of past formulations were taken as conclusive for the basic fallacy of naturalism itself. But were anti-naturalistic positions any less open to criticism? The truth is that a secret animus was at work. But cannot the thinker examine these fundamental questions with the candor and objectivity of the best type of scientists?

In my own thinking, I have always hesitated to identify naturalism with naive materialism, positivism, the mechanical view of nature, or the bias of the physicist to reduce the whole world to facts of physics and nothing more. Has not the time come for the attempted formulation of a more adequate naturalism than those of the past? For a philosophy giving due weight to all the sciences and to the various sides of man's actual nature? The formulations of naturalism have often been narrow and harsh, while the demands of supernaturalism have been sentimental and exaggerated. The warfare between naturalist and anti-naturalist has resembled that between mechanist and vitalist in biology. While vitalism has gained little headway

as a doctrine, it has prevented scientists from falling too completely into dogmatic slumber. But surely the time is becoming ripe for a step beyond the sharp contrasts of the past into a broad and sympathetic empiricism.

The Spirit of Naturalism and Modern Science.—The following characterization of naturalism is true to its spirit: "At first tentative, but becoming ever more distinctly conscious of its real motive, naturalism has always arisen in opposition to what we may call 'supernatural' propositions, whether these be the naive mythological explanations of world-phenomena found in primitive religions, or the supernatural popular metaphysics which usually accompanies the higher forms. It is actuated at the same time by one of the most admirable impulses in human nature—the impulse to explain and understand, and to explain, if possible, through simple, familiar and ordinary causes."[1] The spirit of naturalism would seem to be one with the spirit of science itself. And many formulations of naturalism have been the products of the speculatively inclined scientist in his moment of indulgence in far-reaching generalization.

The specialist works in his own field in accordance with the technique which he has inherited and refined. His is the task to secure data that will help to solve specific problems; and his views are often the reflections of his methods and habits. Yet if he is a man of keen curiosity with some natural bent for wider thought, he will sooner or later formulate views concerning the larger relations of things. In short, he will assume the role of philosopher and interpret fundamental questions in the light of the concepts and data with which he is familiar.

But these concepts and data are not necessarily *sufficient* for the foundation of an adequate naturalism. How could

[1] Otto, *Naturalism and Religion*, p. 18.

the physicist expect to do justice to chemical processes? Or the chemist to biological phenomena? Or the biologist to social institutions? Yet the specialist on his philosophic adventures is only too prone to postulate not only the truth of his categories but their sole sufficiency for all the problems confronting the mind. As against such an assumption, we shall argue that *all* the sciences contribute to the solution of ultimate problems. To attempt to solve the basic queries as to the nature of life in the light of physics alone is to challenge failure or a resort to sophistry.

Modern science has worked in favor of naturalism more successfully through the implications of its results than by means of wide-reaching speculation. It is the direction of the drift of the complex movement that is sensed. Hence, I shall be compelled to be rather hard upon the inadequate speculations of the older generation of thinkers even while sympathetic with their purpose. The time was not ripe for a philosophy of nature.

Two Common Forms of Speculative Naturalism.—Let it be borne in mind that we are not denying that science leads inevitably to some critical form of naturalism. The arguments of this book will show clearly enough that I believe that an adequate naturalism can be worked out. What we are suggesting is that the interpretation of the results of science is a far more difficult undertaking than has at times been realized. Consciousness, for instance, must be gotten into nature in a specific way in connection with the mind-body problem and not by throwing it into nature in a lavish and wholesale fashion. The two common forms of naturalism which we shall briefly discuss represent two stages which do not seem to come up to this critical level. The second form, positivism, comes nearer to this ideal than does naive materialism, the first form.

Naive materialism is a form of naturalism which has

played a very important part in the history of thought. It is often now carelessly thrown aside with the remark that we know too much about matter now to take it seriously. I am not so sure of the truth of this statement. The newer views of matter are far more subtle than the views of a few generations ago. But I must admit that it is seldom easy to know the exact idea of the physical world held by either materialists or anti-materialists. Both are stronger on assertion than on exposition.

The older materialism declared that physical reality consists of matter and motion. The notion of matter was probably that of the science of the period—hard particles affecting one another by contact. Just what the stuff of these particles was conceived as being I cannot make out. In short, it seems to me that this older materialism was largely the generalization in an uncritical fashion of the dominant mechanical view of the world. And just because it belittled such grave questions as those presented by life and mind or else had inadequate conceptions of these realities, it did not fulfil the conditions of an adequate naturalism. Naive materialism never realized the importance of epistemology. How do we come to know matter? The world we see is clearly a sensuous world; the world of matter in motion is an abstract, conceptual world. By what right do we pass from the one to the other and declare its superior validity? It would seem that the materialist of the uncritical type passes to a schematized vision of the physical world much as the interested reader uses words as mere symbols of meanings. He tends to give scientific concepts a vague ontological existence as intuitions of the very stuff of physical being. I frankly confess that it is not always easy to do justice to naive materialism just because it is not philosophically articulate. I think that it was Royce who said that the materialist was the thinker who believed that all phenomena could be expressed in terms of

differential equations of the second degree. There is a large measure of truth in this characterization. The scientist is only too apt to exalt his science's formulas and to make them universal. The materialist is the naturalist who reads nature in a limited way and believes that he has exhausted its possibilities.

I frankly recognize that there is a measure of arbitrariness in this description of materialism. It is a term which, after all, has no univocal meaning. For some, it means little more than naturalism as a sort of faith. They would reject any but the most modern ideas of matter and energy. Yet I think that materialism can rightly be associated with a certain degree of epistemological simplicity and with a tendency to reduce higher natural processes to lower without a remainder.

Scientists who have given themselves to speculation often temper their physical realism with agnosticism and animism. Thus Büchner argues that matter and force are inseparable. "There is no force without matter—and no matter without force." The stuff of the universe is dynamic. Matter is that which *manifests* itself in the various energies of light, heat and motion. These energies are measurable, but that which lies back of them is *unknowable*. But just because matter is unknowable, it can be endowed with all sorts of potentialities. It can be endowed with intellectual force as well as with physical force. It is noticeable that Spencer, although far more sophisticated, argues in much the same fashion that force is an unknowable source for all the phenomenal effects we experience. "By the Persistence of Force, we really mean the persistence of some Cause which transcends our knowledge and conception." Spencer's looseness of thought has been so unsparingly exposed by Ward that it is hardly necessary to go over the ground again. It should be noted that there is an unbridgeable gulf between our experiences and this

unknowable, and that persistence means alternately quantitative constancy and permanence of being.[2] Haeckel is another example of the militant scientist on speculation bent. The following quotations give some idea of his daring generalizations. "The two fundamental forms of substance, ponderable matter and ether, are not dead and moved only by extrinsic force, but they are endowed with sensation and will (though, naturally, of the lowest grade); they experience an inclination for condensation, a dislike of strain; they strive after the one and struggle against the other." "Attraction and repulsion seem to be the sources of *will*—that momentous element of the soul which determines the character of the individual." Haeckel is obviously fighting for continuity. *But is continuity of an evolutionary type opposed to novelties*? There is another feature of this naive naturalism to which attention must be called. The experts in other fields are rather despised. Thus he pays his respects to psychologists after this fashion: "Most of our so-called 'psychologists' have little or no knowledge of these indispensable foundations of anthropology—anatomy, histology, ontogony and physiology.... Hence it is that most of the psychological literature of the day is so much waste-paper."

What shall be our comment upon these analogous forms of materialism? I think that our chief criticism must be that matter and energy become unknowables to which are assigned in a verbal way just those capacities which are necessary to meet unpleasant problems. What explains everything in this enigmatic fashion explains nothing. The intention is in a way commendable. Reality must be of a sort to account for the world as we experience it. Yet the connection between reality and experience is of the slightest. Philosophy becomes unanalytic and vague, a series of

[2] Cf. Spencer, *First Principles*, sec. 191, stereo. ed., p. 552; and James Ward, *Naturalism and Agnosticism*, 4th ed., p. 213.

assertions which are not explanatory because knowledge of the unknowable is contradictory. Can the unknowable evolve and acquire new properties? Or is it always and everywhere alike in a static and dead-level way? The familiarity of the terms used suggests a directness and specificity which they do not possess as metaphysical symbols. We swing back and forth between scientific realism, for which matter and energy are determinate entities, and a vague agnosticism in which they are postulated as sufficient reasons for whatever occurs in the phenomenal realm.

The shortcomings of these uncritical forms of naturalism led scientists, better acquainted with the history of speculation, to develop various forms of *positivism.* There may, or may not, be a reality outside the reach of experience, but science affords us the only valid knowledge we can attain. The methods of the physical sciences have justified themselves by their results. Here are data cooperatively found and recoverable; here are empirical laws stating invariable relations between terms. This information satisfies the intellect and guides human behavior in successful ways. What more can be desired? The aims of metaphysicians are illusory. There are no things-in-themselves, no substantial reality of a transcendental kind. Terms like matter and energy and force should be kept to their analyzed, empirical meaning; for they are merely concepts descriptively useful in the organization of experience.

These positivistic forms of naturalism when examined in detail in the writings of Pearson, Mach and Poincaré show how dependent a naturalistic philosophy is upon theory of knowledge. Although securing much of their prestige from their standing as scientists, they plunge immediately into psychology and logic. Pearson becomes a Humean sensationalist. Mach seeks to establish neutral entities or elements which are physical and psychical according

to their relations. Poincaré attempts to justify science by demonstrating the exactness of its results and the control exercised by the facts of observation. Thus they write, not so much like scientists indicating the reality of the physical world and of the validity of our knowledge of it, as like descendants of Hume and Kant. They succeed in showing the naïveté of old-fashioned materialism and the uncritical use of scientific concepts by speculative naturalists, but they cannot be said to prove the sufficiency of their own positivism. In short, they are philosophers whose training has been in science rather than in philosophy. Consequently, they possess the defects as well as the merits of their training and outlook.*

Is it too much to assert that the speculations of scientists turned philosophers have demonstrated the necessity of theory of knowledge as a condition of an adequate naturalism? The need naturalism has for a well-founded epistemology has thus been made clear both by its exponents and by its critics. It is, as James Ward points out, a tentative philosophy, and yet a philosophy which has not taken advantage of the critical analyses offered by experts in the field. But why has it neglected these offerings? For two reasons in the main. The scientist has become a specialist seldom acquainted with the situation in philosophy, and, what is more, inclined to be contemptuous of it. Hence, when he starts to speculate, he does it boldly from his own stock-in-trade. In the second place, nineteenth-century philosophy was largely romantic in its bias and itself inclined to be condescending to science. Instead of cooperating, science and philosophy went their separate ways. But this cooperation is an essential condition of the discovery of a true naturalism.

The Situation in Philosophy.—Above the technical dif-

* For a more detailed criticism of these thinkers see my *Critical Realism*, Ch. 2.

ferences between the various schools of philosophy and to a certain degree determinative of them, worked the opposition between naturalism and romanticism. Idealism has always been anti-naturalistic and favorable to what—for lack of a better term—may be called a religious view of the world. Naturalism, as we have already noted, represented the drift toward a lawful and, so far as possible, physical explanation of events.

While naturalism swung between materialism and positivism, idealism was able for a long time to present a unified front to its opponent. Especially was this the case in the English-speaking countries. Objective idealism was the dominant academic philosophy in England and the United States during the latter half of the nineteenth century. And idealism worked hand in glove with romanticism. It is not strange that the half-articulate naturalism of the time found it hard to cope with such an enthusiastic combination. Yet, on its side, it felt the comfort and support of the vigorous sciences springing up around it. The prestige of science confronted the prestige of religion. The tactical skirmishes between naturalism and idealism were practically always in favor of the latter, but the pressure of numbers on the other side made these victories Pyrrhic.

But the end of this period found new movements in philosophy. The ascendency of objective idealism was rudely challenged by pragmatism and later by realism. Pragmatism sharply criticized the constant appeal made by transcendental idealism to absolute and virtually non-human standards. It opposed the too-facile monism and dialectical temper of approach of its opponent. Thus the banner of empiricism was again raised and in a more critical form. The fruit of this new spirit is an alliance with the social and biological sciences and a flirtation with naturalism. Perhaps its weakness has been an unwillingness to develop a systematic metaphysics. And yet, in its latest manifesta-

tions, there can be no doubt of the sympathy of an instrumentalist pragmatism with a more broadly conceived naturalism.[3]

Realism is in deadly opposition to the cherished assumptions of idealism. While idealism has always maintained that the physical world as common sense and science conceive it is illusory if taken as more than phenomenal, realism accepts its independence of the knower and the non-mental character of nature. It will, I hope, be noted that I say non-mental and not anti-mental. As we should expect, realism finds itself in sympathy with the temper and ideals of science. Accordingly, the rise of realism makes possible that cooperative supplementation and interpretation of science by philosophy in which alone lies the hope of an adequate naturalism. Since the whole argument of the present work will concern itself with the pregnant union of science and realism, we need not stress the point further at present. In short, the situation in philosophy has ceased to be unfavorable to naturalism.

The Idealistic Criticism of Naturalism.—The current criticism of naturalism deserves attention; for those who desire to establish an adequate naturalism must heed the objections in the controversial literature. The whole truth was by no means on the side of the older naturalism, even though it did not reside in the camp of idealism (spiritualism) either. What is desirable is not eclecticism but a thorough overhauling of assumptions.

In the main, the chief objections to naturalism of the traditional sort fall under four headings: (1) the denial that the higher can be reduced to the lower without a remainder of supreme importance; (2) the claim that description is not explanation; (3) the existence of gaps in nature

[3] This drift of pragmatism toward naturalism comes out quite noticeably in *Creative Intelligence*, a series of essays by American pragmatists. In his review of the last edition of Ward's book, McGilvary points out this fact.

disastrous to naturalism; and (4) the refutation of realism or, as it was usually called, dualism. Let us glance at these objections. We shall see that they need careful interpretation to separate what is true in them from what is false.

We shall admit that there was much truth in the contention that the older naturalism sought to oversimplify by reduction, and we shall try to indicate the historical reasons for this mistake. Probably they reduce to two: the nonage of the biological sciences and the continued dominance of the kinetic conception of all physical processes. The idea of evolution was either unknown or its full implications unappreciated. The first tentative efforts at the application of the idea of evolution were wooden in the extreme. The fact of the matter was that the various connective sciences between physics and politics had not yet sufficiently developed to reach hands across to one another. Naturalism desired continuity between the various apparent levels of nature, but at first could conceive it only as meaning that the higher is nothing but the lower. But supernaturalism—and idealism was often ready to give it comfort—was friendly to the idea of discontinuity. The one wished to achieve continuity by a rough and dogmatic reduction; the other to establish discontinuity. The conditions of an adequate naturalism had not yet been reached.

The claim that description is not explanation itself needs explanation. To explain an occurrence is to give its *why*, the cause or conditions out of which it sprang. Such explanation is, in logic, contrasted with mere empiricism. To explain is to solve problems by the discovery of laws and relations, which are, to my way of thinking, cases of well-formulated knowledge about nature. Wrongly, I think, explanation is frequently thought of as a reference of events to an unseen essence or productive activity. When *explanation* is so conceived, the work of science is said to be detailed *description* of things and events as research pre-

sents them to our minds. It is what I would call knowledge about the physical world. Explanation of events must rest for us in such descriptive knowledge about their conditions and setting; and the logic of investigation must convince us that there is an essential fidelity to reality in such descriptive explanation. Professor Ward's thesis that such symbolic description as characterizes modern science is arbitrary in anything else than the symbols used is agnostic and unjustified.

What these critics of scientific explanation have in mind is, so far as I can make out, something as follows. We cannot intuit nature so as to appreciate the inner necessity which moves things to act as they do. Perhaps it would be better to speak of the inner expression of things of which their behavior is a function. Laws give knowledge about things in relation but no living glimpse into their counsels. To say that A attracts B is to say that B approaches A. But can we *sense* this attraction, this dynamic continuity which has this result? Assuredly not. Hence science does not really explain.

But can any other discipline penetrate to the veritable springs of change? Only the idealist makes this assumption, and he claims to achieve this ideal by analogy. Cause is desire and will. That may be, yet the scientist may well reply that what explains every event explains none. Scientific explanation with its specificity and genuine knowledge about things is as necessary and as valid as ever. The critics of science believe that they can supplement science and, I suppose, hope to clear the way for some mysterious teleology more harmonious with idealistic hopes than the matter-of-fact results of science. I must admit that I can see no escape along this path. There is a discoverable orderliness, massiveness and immanent executiveness about nature.

The frequent emphasis by idealists upon supposed gaps

in nature cannot be regarded as an attack upon naturalism alone. On this point, naturalism and science are in the firmest alliance. Religious idealism displays a disposition to belittle science itself, and to build upon the fact that its tremendous tasks have not yet been completed. But those who comfort themselves in this way are like squatters who fear that the rightful owner may at any time appear and claim his property. The history of the struggle between vitalism and the physicochemical view of life illustrates this situation very well. As long as vitalism stood for a protest against too easy solutions, it was justified by the prodding it gave to facile dogmatism. But when it represented an appeal to some factor out of physical nature, it hampered research. Advances were achieved in spite of it instead of by it. Let us admit that the conception of evolution is an hypothesis. What better systematizing theory is there to put in its place?

But the strategic attack upon naturalism made by spiritualism has always involved the supposed proof that physical realism is epistemologically faulty. We shall have much to say of this in the next two chapters, but we have already paid our respects to the contention, elsewhere. Spiritualism has been avid to prove that science deals only with phenomena. Granted this by bewildered science, it has gone on to argue that orderliness and intelligibility of phenomenal arrangements implies an orderer. We might well ask it to supply the major premise of this argument. May not our own intelligence be an expression of this innate orderliness of nature? But the assumption which modern realism will not admit is that nature is phenomenal. We know nature through the data it controls in our minds. The data, not nature, can be called appearances.

The Inadequacy of Past Naturalism.—Aside from its philosophical immaturity, past naturalism had three main

weaknesses. These we have in a measure already rehearsed, but a degree of repetition from another angle may be of advantage. Naturalism sought too blindly to reduce or disintegrate, as though novelty could not arise, as though the organic could be only the inorganic. It was dominated almost entirely by the exact sciences with their stress upon quantities. And it did not enough recognize the reality of mind and of those human organizations and events for which mind is pivotal. In brief, past naturalism did not take evolution seriously nor did it take mind seriously. As we shall try to show in the course of our general argument, these two shortcomings are very closely connected. An adequate naturalism must reckon without condescension with biology, psychology and sociology.

To explain by means of analysis is an ideal native to science. Only by tracing strands of dependency in the physical sciences, only by abstraction and selection in the logical sciences was knowledge able to advance. Experience comes to us too complex and interwoven for comprehension. Hence the early history of science is an account of the successful reduction of the complex to its elements. Movements are shown to be the resultant of components and optical processes of many vibratory factors; heredity to be carried by correlated unit-characters; personality in some measure an organization of acquired habits; and chemical compounds of recoverable elements.

But in its zeal for analysis, science often forgot the fact of synthesis. Because it could disintegrate and identify, it tended to ignore the organization which had been dissolved. In other words, the temptation was to level down, to say that chemical compounds are *nothing but* the atoms into which they can be disintegrated, to refuse to see the significance of the dynamic whole upon which operations had been performed. The result was a *naturalism of reduction*. The following quotation from James is a relevant

criticism of this reductive naturalism: "The mention of material substance naturally suggests the doctrine of 'materialism,' but philosophical materialism is not necessarily knit up with belief in 'matter' as a metaphysical principle. One may deny matter in that sense, as strongly as Berkeley did, one may be a phenomenalist like Huxley, and yet one may still be a materialist in the wider sense, of explaining higher phenomena by lower ones, and leaving the destinies of the world at the mercy of its blinder parts and forces."[4] The old naturalism ignored novelty and evolutionary synthesis. An adequate naturalism must not make this mistake.

Was there not a tendency in the past to confuse conceptual analysis with physical analysis? The anti-intellectualist of to-day complains that analysis changes the facts or ignores relations. To assert that an organism has parts seems to him to deny that these parts are interdependent. To this complaint the realist can only reply that he does not see the necessity. But physical analysis, actual dissection, does destroy the whole. And there can be little doubt that kinetic theories favored the identification of physical and conceptual analysis.

This brings us to a consideration of the second source of weakness of past naturalism. It moved within the circle of ideas and facts native to the exact sciences. The consequence was an incompleteness of which thinkers interested in biological and mental facts rightly complained. The world tended to lose space-and-time-filling content and to assume a purely mathematical character. The evolutionary differences in nature were ignored as irrelevant. We shall have more to say of this situation when we come to treat of the mind-body problem. Recent discoveries in physics have, however, put a stop to this abstractive tendency. The physical atom has come to its own once more.

[4] James, *Pragmatism*, p. 92.

complishments of science, the philosopher can pride himself that his function is like that of an artist who adds finishing touches here and there to some massive, cooperative work. The evolutionary naturalism which the keen eye can discern is like the statue hidden in the marble. Much must be done before it can be released. Just because the common result of all the sciences is the concern of no one science, there is need of a discipline of a comprehensive nature.

As we have constantly suggested, the cooperative assistance open to philosophy takes two lines: epistemology and the analysis of the categories. Seldom is science aware of the need of a theory of knowledge, yet the scientist who attempts to speculate stumbles around rather blindly for lack of it. On the other hand, science begins to make use of new concepts or categories long before it has clearly formulated them. We should expect this "lag" if we bear in mind the fact that categories have their birth in experience and that experience comes bit by bit in new fields. A critical eye, not concerned primarily with specific problems, can note changes of ideas and methods of interpretation that the busy specialist will overlook. To analyze and comprehend these large "forms" of cognitive experience is the self-appointed task of the philosopher.

If naturalism is usually an implicit system of philosophy. let the philosopher who is in sympathy with science make it explicit. Let him honestly face all difficulties and at least show how they can probably be met. His can be no narrow naturalism limited to the physical sciences. The *whole* of man must be included in nature, and nature so conceived that this inclusion is possible.

R. W. SELLARS.

UNIVERSITY OF MICHIGAN.

EINSTEINIAN SPACE AND THE PROBABLE NATURE OF BEING.

AN ADVENTURE IN METAPHYSICS.

THE achievement of Professor Einstein of Leipzig University, after long and thorough discussion, is recognized by science as the greatest feat in pure mathematics as yet accomplished by the human mind; though, as is to be expected, the ultimate validity of all of his conclusions does not enjoy quite the same status.

That he was anticipated in some respects by Oriental philosophers a thousand years before Christ does not detract from his own work, which was carried out independently, from different bases and by different methods.

We will not deal here with the mathematical mechanism of his work, which is of the nature of calculus of a very advanced form, and which it is said is understandable to only a dozen men in the world; but will deal with certain consequences and some possible interpretations therof.

The most important consequence is the concept of time as a fourth dimension of space. We are familiar with the common mathematical representation of the three dimensions of space; length, breadth, and thickness. These dimensions are represented by three lines, each at right angles with the two others. The possibility of a fourth dimension, representable by a line at right angles with all three of our present axes (a condition inconceivable to the human mind), has long been discussed.

Einstein seems to show that this fourth dimension actually exists, being none other than our familiar, but incomprehensible entity, time itself. In other words, the illusion of time proceeds from a translation of the observing entity through the true four-dimensional space, the events passed through remaining unchanged and permanent in position in true space. By a rigid mathematical demonstration, he shows that the axes by which any given observer locates and orients himself in time and three dimensional space (that is, in true space), may be made to coincide with any other set of axes by a simple process of rotation; concretely, time may proceed in one direction in one part of the universe, and in some other direction in another part, simultaneously. The inevitable deduction is the eternal coexistence of all things in a universe whose component parts are changeable only in their time-space relationships.

In our three-dimensional space, the path of a particle forms a line representable by its projections on the planes determined by the three axes of reference. In Einsteinian space the same rule holds good, but the concept must be extended to include a projection on the additional plane postulated by the existence of the time-dimension. This projection is what appears to us as the passage of an entity through events. The true and unique path of the entity through time-space is termed by Einstein the "world-line."

Since two entities can contact one another only when they meet in both time and space, a meeting of entities implies an exact intersection of their respective world-lines. If a human mind becomes conscious of any other entity, of any nature whatsoever, it can only be because the world-line of that mind intersects that of the other entity in time-space at that particular point.

Let us leave this development for the moment.

Einstein assumes (and seems to prove) that energy is affected by gravitation. In fact, if matter is a form of

energy, this must be the case; and modern research tends more and more to that hypothesis.

If this be so, then all things are subject to the influence of gravitation, since, giving the term its widest possible meaning, nothing exists save energy and its modification, matter.

Calculating upon this basis, Einstein correctly predicted certain astronomical phenomena; and other possible confirmations are still under test.

A hypothesis in good standing at the present time is that of the curvilinear nature of space. I cannot say just what its origin is, or what relation it bears to the more general aspects of Einstein's theory, so must leave the discussion of its validity to deeper students, while presenting for what it may be worth, a hypothesis erected thereupon.

From here we will attack the problem of being with three assumptions: time as a dimension of true space, all existing things as modifications of energy, and the curvilinear nature of space.

It is not illegitimate to consider consciousness and its activities as forms of energy; in fact, it is not conceivable that they can be anything else. From this we may imagine that the matrix of consciousness, which we will term Being for convenience, is a form of that which manifests as material phenomena, or matter and energy. Let us go another step and consider that Being is the original and primal substance of the universe, capable of that movement or modification which we term consciousness; and that consciousness manifests only upon some manner of contact; including in the word contact all forms of sensation, mentation, etc.

Thus the only distinction between a conscious and an unconscious entity would be in the nature of their respective contacts; and not at all in their essential substances.

Thus the substance of Being in the atoms of a stone appears as unconscious to the perceiving mind simply because the world-line of the mind intersects the world-lines of the atoms of the stone at such angles that contact with the mind does not arouse consciousness within the Being stuff of the stone.

It will be noted that on this hypothesis we must define the atoms of the organs of perception as belonging, during the process of perception, not to the mind-combination, but to the stone-combination; and we must imagine the mind as looking on at the process of perception, but not taking part therein.

As a matter of experiment, let us drop all preconceived ideas, and start afresh with the only statement of whose truth we can be sure, in the ultimate meaning of the word: "I think, therefore I am." Let us follow this with the next most reasonable hypothesis: we think only when stimulated by contact; a single mind in the universe however potentially conscious it might be, would never develop actual consciousness; therefore something more than the I which thinks must also exist. Let us add another reasonable hypothesis: that the ultimate laws of nature are probably of the utmost simplicity.

Now we have: A certain sure fact and two reasonable assumptions:

First: I am.
Second: Something else is.
Third: The ultimate law of That Which Is is simplicity.

And three apparent facts:

First: Four-dimensional space, time as one of the dimensions.

Second: Space is curved.

Third: All is of one nature, possibly energy, say Being.

It will be noted that number three of the second series would follow from three of the first series; and we will show that the second of the second series would also follow from it. It might also be said that the first of the second series comes in this category as well, for time as an integral dimension of space is surely a simpler idea than time as a separate, unrelated, and altogether unknown thing.

Reasoning from the postulate of simplicity, let us take our bases in order.

The utmost simplicity of Being would lie in the existence of a single entity in the universe; but we have seen that more than one entity exists, and we may as well admit at once that an infinite number may exist, for infinite multiplicity, from the philosophical standpoint, is just as simple as duality. So let us fall back upon the next most simple assumption: that the component entities of the universe are exactly alike in all their qualities, and that all are like particles of the stuff of Being itself. Term these entities monads. As to their nature, it must for the present remain purely metaphysical; they certainly must be some more primitive manifestation even than electrons; perhaps an electron may be made up of thousands of monads. Note that each monad is potentially conscious, containing all the possibilities of sensation and mentation, possibilities which become actualities only upon contact with other monads.

The path of each monad through time-space, must, from simplicity, have the same form of equation as that of any other monad. The simplest equation is that of a straight line. For the time being, then, let us imagine the world line of each monad as a straight line; we shall see later that

a straight line is the simplest form only from the standpoint of three dimensional space.

To get at the nature of space from the assumption of simplicity, we may reason thus: three-dimensional space is either limited or unlimited: if limited the simplest form is seen at once to be a sphere.

If three-dimensional space is unlimited, then the form of four dimensional space is the metasphere whose shadow in three-dimensional space is the sphere; for unlimited space is that in which a line of unlimited length may be produced in any direction, and if three-dimensional space is considered as the surface of metaspherical four-dimensional space, this holds good, since the simplest form of a line in the surface of a sphere is a circle, which is endless.

To our three-dimensional senses, such a circle would appear as a straight line as far as seen, since our only criterion of straightness would be such a circle itself.

Of course, if three-dimensional space is curved, the simplest form of curvature would be the surface of the metasphere. As an additional support to the curvilinear theory, it will be noted that the human mind can make some approach to the idea of the fourth dimension by its aid, and none at all without it.

It will be noted incidentally that if three-dimensional space is in the form of a metaspherical envelope, our conception of space has nothing at all to do with the true extension of space; space may be of infinite extent or of infinitesimal extent, using the words in their usual meaning. It may be even non-existent to all human conceptions.

Using the idea of an infinite number of similar monads following an infinite number of similar paths, let us bring the conception down to our level by subtracting a dimension from each of our factors, so to speak, thus imagining ourselves as animals conscious only in a surface.

Then we have for true space, a sphere; for our per-

ceptible space, the surface of that sphere; for the monadic world-lines, circles inscribed in that surface, and for the monads, beings capable of contracting one another only when their circles intersect.

The monads move; otherwise there would be no manifestation; the "I" could not think. The simplest form of motion is uniform motion in a straight line; but the straight line of three-dimensional space is the circle on the surface of the metasphere. So we have the monads in uniform motion along the circles inscribed on the surface of our sphere. By simplicity, each circle would be a great circle of the sphere. An infinite number of great circles may be drawn for any sphere, intersecting in an infinite number of points at an infinite number of angles.

Therefore any one monad, starting from a point and returning thereto, might experience any given number of contacts in the course of its cycle. Any experience which a monad undergoes would be the integration of the contacts experienced at that point in time-space, and its nature would be determined by the number of other monads taking part in the meeting, and the angles of intersection of their world-lines. All events, of course, would be absolutely cyclic, recurring as often as the monads completed their circles. We are struck here by the fact that the greater number of events perceptible in nature really are cyclic; and it is reasonable to suppose that such as do not appear so to us, do not so appear, simply because we cannot see enough of the arc to perceive its circular nature.

Thus we have a hypothesis by which the simplest form of Being, following the simple form of path, in the simplest form of space, gives rise to all the visible phenomena of our universe.

There are innumerable consequences to this hypothesis, upon some of which we will touch.

First, immortality would be an absolute fact, whatever the nature of the soul might be, for all things would be periodically reconstituted. However, in order to satisfy the emotional desires of the normal mind, it would be necessary to prove that the periodical existence of the soul is of greater scope than that seen in our present lives. This, however, might well be the case, as the above seems to demonstrate our absolute present ignorance of true reality.

Second, all experiences and existences perceptible to us, must in the philosophical sense of the word, be pure illusion, owing their apparent orderly sequence to some geometrical pattern in the arrangement of the monadic world-lines; a pattern which it is reasonable to suppose would be of utmost simplicity in some way.

A simple syllogism furnishes an added piece of evidence as to the cyclic nature of Being.

Something cannot arise from nothing; something now exists, therefore something always has existed. That which exists undergoes constant change; if the changes led to any fixed culmination, that culmination would have been reached in the course of past eternity, and no changes would now be taking place. By all our known laws, all the energy in the universe would have flown to a dead level, and all things would now be motionless and consolidated in a single dead mass.

If all movement is not cyclic, some power must have interposed to reverse the current of events, to change for a time the laws of nature. This conception is repugnant, and not to be compared with that of a cyclic universe with immovable and unchangeable contents and laws.

Now, the reader has probably observed that we are standing on the edge of a gulf into which it is not well for the human mind to look too long; for the periodical nature of manifestation implies a thing which bears the same

relation to four-dimensional space which time bears to three-dimensional space, and so on *ad infinitum*.

With this observation we return to the world of sanity and normal mentation, leaving to bolder and better equipped minds the further development of the idea.

CAPT. VICTOR A. ENDERSBY.

CRITICISMS AND DISCUSSIONS.

THE MEANING OF CHANCE.

Examinations of the concepts of *chance* spread as if by a kind of logical contagion through the three broadly distinguishable fields of philosophy—metaphysics, logic and the theory of knowledge. A confusion of these three aspects of the subject has caused much of the difficulty in determining what a judgment of chance measures, and in showing the place of the laws of chance among the other laws of logic. With the hope of avoiding some of these confusions and of giving a sharper definition to the concept, the present essay will treat chance under these separable heads: the logic of chance, the epistemology of chance, and the metaphysics of chance.

The Metaphysics of Chance.

Chance as a concept often accompanies indeterminism. There can be no real chance in a deterministic world, we are told, nor any determination in a world of real chance. Upon this issue two radically opposed types of metaphysics arise. They are at one only in agreeing that chance is to be linked to some ultimate principle of reality.

Says the determinist: "There is no doubt in the lightning as to the point it shall strike;....not a grain of sand lies upon the beach but infinite knowledge would account for its being there; and the course of every falling leaf is guided by the principles of mechanics which control the motions of the heavenly bodies. Chance can not exist in nature."[1]

If there were a world of real chance, the determinist would

[1] Jevons, W. S., *Principles of Science*, Ch. X, pp. 197-8.

look upon it as a chaos. But according as one has or has not a liking for revolution and novelty, one becomes a *tychist* or a strict determinist. Peirce, who invented the term *tychism*, says: "Now the only possible way of accounting for the laws of nature and uniformity in general is to suppose them results of evolution. This supposes them not to be absolute, not to be obeyed precisely. It makes an element of indeterminacy, spontaneity, or absolute chance in nature."[2] Peirce refers to this as "that way of thinking which it will be convenient to christen tychism."[3] Thus, on the one hand, is a Bergson or a James insisting upon change, newness, deviation from law as the ultimate truth about reality; on the other, a Jevons or a Mill holding fast to necessity, and causes and effects.

A definition of chance which sets out from either of these metaphysical premises must solve the dilemma of chance and necessity by making one or the other a superficial character of experience. Chance must be appearance and necessity reality, or vice versa.

If the universe is tychistic, the causal connections in it will be like habits in the life of a man who has no general plan of living. They are temporary uniformities, crystallizations out of the flux. They will give way to new and different uniformities. No law is eternal except chance; the laws of nature by which events seem to be determined are an insecure crust upon the deeper flow of change.

The usual view is the reverse. Most writers hold that chance is the illusion and necessity, the reality. This view makes a stronger appeal to common sense. Human habits of thought make it easier to believe that "every falling leaf is guided by the principles of mechanics" than to suppose that the principles of mechanics are, themselves, a phase in the lawless transformations of the universe. On this view, every event belongs somewhere in a setting of strict law. If nature appears at times to follow no rule, that is not because there is no rule.

The conventional way of dealing with illusions is to assign them to the mind. This is the classical method of defining chance, with Laplace as authority. Chance is an appearance due to human ignorance. To the all-knowing mind there is only necessity. If we are ignorant of the causes of an event, says this view, we can not predict it with certainty; we can only hold a belief about its occurrence. It seems to follow that the measure of the strength of this belief will be the measure of the chances of the event.

[2] Peirce, C. S., *The Monist*, Vol. I, p. 164.
[3] *Ibid.*, Vol. II, p. 533.

Having first been an appearance, and then a mental illusion due to ignorance, chance now becomes the degree of intensity of a belief. De Morgan states this position in its most radical form. "By degree of probability we really mean, or ought to mean, degree of belief," he says. "I throw away objective probability altogether and consider the word as meaning the state of the mind with respect to an assertion, a coming event or any other matter upon which absolute knowledge does not exist."[4]

We see what are the results of bringing in the metaphysical question of determinism: chance and necessity are distinguished as appearance and reality, and chance is assigned to the mind. If the metaphysical question be not raised, we can discover a neutral view. Neither chance nor necessity need be fundamental, and at the same time both can be intelligibly accounted for. There will be no metaphysics of chance. The nature of reality, whether changing and lawless or strictly determined, will not be in question.

The sanction of this non-metaphysical view is pragmatic. Experience can be treated both as if it were a series of chance events and as if it were bound together by strict laws. But to treat it in either fashion is not to prove that it is *really* one or the other.

Nature presents all degrees of uniformity from the startling appearance of a new comet to the regular motion of the planets about the sun. To certain uniformities we give the name of natural laws. They are those uniformities which have been tested by many observations and fitted into place with other uniformities, and from which no deviation is known to occur. The laws that light travels in straight lines is such a uniformity. But there are other uniformities (the word being widely interpreted) which hold *on the whole*, though not strictly. Such is the uniformity, extensively verified by experience, that about fifty-one per cent. of all births will be female births. This is a statistical uniformity. It admits of variation and exception. It compromises with the disorderly character of the facts by making its demand for uniformity less rigorous.

Statistical propositions afford a means of handling different degrees of orderliness. So long as experience is sufficiently coherent to present *things* or *events*, the statistical method can make some generalizations about the relations between these things or events. The connections in experience thus generalized will be chance connections. No absolute prediction of any event or thing can be made upon them.

[4] De Morgan, *Formal Logic*, p. 172.

To say that anything comes about by chance means, then, that it follows from certain conditions with a regularity which is not absolute. The measure of its regularity (or irregularity) will be the chance of its occurrence. No answer is implied as to whether *reality* is regular or irregular, uniform or disorderly, determined or undetermined.

The world seen under the aspect of chance is the world from a different point of view. It is not a different world. If we frame generalizations which hold on the whole, or in a proportion of all the cases which they cover, we are dealing with experience as a thing of chance. If we frame generalizations which hold without exception, we are dealing with it as a thing of necessity.

We may ask for what reason does one wish to view experience as a series of chance events. Why use statistical generalizations?

In the first instance, some statements of fact can be generalized only in the statistical fashion. It is impossible, for example, to state the general conditions of weather changes so strictly that there will be no exceptions. Statistical generalizations are forced upon the meteorologist by the very nature of his facts.

For the Laplacian theorists of chance this would be a case of human ignorance. To the all-knowing mind, they would say, the weather must be an open book. But the all-knowing mind is only another form of the premise of determinism. Completer knowledge would reveal strict connections only if strict connections existed. If there were no rigid uniformities into which the facts would fit, as the indeterministic metaphysics asserts, then no amount of knowledge would produce a rigid generalization. A statistical statement would be the only possible means of generalizing from the facts.

All generalization is a process of extending human knowledge. It is effective in proportion to the range of facts included and to the elimination of human ignorance. Statistical generalizations are no exception; they are an attempt to surmount ignorance. But only upon the deterministic assumption can human ignorance be said to be the *raison d'être* of the statistical method.

Secondly, statistical generalizations may be used for convenience. Strict laws by which the phenomena in question are determined may or may not be known. Such for instance would be the statistical distribution of molecules assumed in the kinetic theory of gases. Each molecule obeys the laws of motion; but it is not convenient to calculate what each molecule would do. Statistics are

thus suitable for synoptic views. The all-knowing mind, even in a determined universe, might prefer to class together many events and deal with them as masses, rather than to follow out the tedious details of each. It is obvious that in such cases the extent of our ignorance or knowledge would not affect the chances involved.

Chance, therefore, need not be defined in metaphysical terms. The use of statistics does not imply that reality is either determined or undetermined; and the utility of the statistical method does not rest upon ignorance.

The Epistemology of Chance.

We have shown that it is a short step from the deterministic view of chance to the corollary that a degree of chance is the degree of certainty or uncertainty of a belief.

What is the relation between belief and judgments of chance? This is the epistemological question.

To affirm, for example, that the chances of death at sixty are greater than the chances of death of twenty-five appears to be a plain statement of fact. Like any statement of fact, it may be believed or disbelieved. The intensity of the belief will not constitute its likelihood. If the likelihood of a proposition believed were created by the intensity of the belief, necessity would be created by irresistible conviction. A judgment such as the one just given refers to the facts of experience, as does any other judgment. It states in the last analysis that more people die at sixty than at twenty-five. This is its factual content. If this is true, it will be a correct judgment of chances. We need no special category of knowledge in which to place it.

This is proper enough, it will be answered, so long as we confine ourselves to the statistical generalization—that the proportion of deaths among men of sixty is greater than the proportion of deaths among men at twenty-five. But suppose we inquire about the probabilities of Tom Jones's death at these two ages. We must then affirm that a particular proposition, "Tom Jones will die at twenty-five," has a probability. Is this a statement of fact? Certainly we do not affirm the fact to which the particular proposition refers: we do not say that Jones will die at twenty-five. Neither do we deny it. But we do affirm something, which is a fact, about the whole proposition. We say it has a certain probability. Now, the probability that Jones will die at twenty-five is the same as the

probability that *any* man will die at twenty-five. Jones is a specific value for the indefinite article "any." What we are affirming about the probability of this particular proposition can also be affirmed about a class of propositions, viz., about all the propositions which assert that someone will die at twenty-five. It is because the particular proposition is one of a class of such propositions that the particular proposition can be judged probable. The judgment of probability is a statement of the fact that a certain number of the propositions in this class are true and a certain number false. The statistical generalization that "*ten per cent.* of all men die at the age of twenty-five" is another way of stating that "*ten per cent.* of all propositions which assert that some man will die at twenty-five are true."

The relation between a judgment of the chances of a particular event and the statistical generalization upon which it is based is a matter of logic, and will be treated as such under the logic of chance. It rests upon the axiom that what is true of all members of a class is true of a particular member. Statistical generalizations deal with classes of propositions; and hence, the frequency of truth found in the class will be the probability of any particular proposition of the class. One may either correctly or erroneously believe that this truth frequency has a certain value. But the belief will not affect the value.

This is simple enough and yet the point has been a source of endless confusion. A particular proposition, we are told, must be either true or false, with no middle ground. Probability seems to be such a middle ground and, therefore, it must be an illusion. But it is evident that a particular proposition may be true or false and also probable. "Tom Jones dies at twenty-five" will be true or false as the facts decree. It may be also probable, because the judgment of its probability does not either affirm or deny that the proposition is true or false. There is no contradiction here. The judgment of its probability lies in another plane.

Bound up with the view that chances are created by human beliefs is the prejudice that chance refers essentially to the future. But whether the event whose likelihood is in question has or has not come to pass, it remains a chance event. Either before or after Tom Jones's death, the probability that he will die before he is twenty-five has a meaning and a numerical value. This is a corollary of what we have said before. There is no absurdity in speaking,

after Jones's death, of the probability that he might not have died, which is an admission that his death is still in the realm of the probable, though it has actually come to pass. Very often past events are spoken of as improbable, surprising, or unlikely. If probability did not exist after the event as well as before, such a habit of speech would be pure nonsense.

It must be concluded that chance is as objective as any matter of fact. It belongs in no way peculiarly to the belief side of knowledge. It is a matter of experience to be handled by observation and ordinary methods of verification.

The Laplacian theory of chance is often called objective, but it is far from being objective in the sense just defined. Laplace says: "The probability of an event is the ratio of the number of cases which favor it to the number of all possible cases, when nothing leads us to believe that one of these cases ought to occur rather than the others, *which renders them for us equally probable.*"[5] It is the last (italicized) clause of this definition which makes probability objective. This is the equal distribution of ignorance. The fundamental axiom of the theory is: where nothing is known about the likelihood of an event, its probability is one to two. It is as likely to happen as not.

This axiom may be taken as self evident or it may be grounded in experience, as it is by Edgworth. "I submit, the assumption that any probability constant about which we know nothing in particular is as likely to have one value as another, is grounded on the rough but solid experience that such constants do as a matter of fact as often have one value as another."[6]

In any case, ignorance is a very poor ground upon which to base knowledge. We have mentioned reasons for disregarding ignorance as a factor in chance. It is peculiarly difficult to understand why we should be permitted to prescribe that an event of whose conditions we know nothing must occur in fifty per cent. of all cases. Any other guess would be equally permissible. Each *a priori* guess of the probability of an event must wait for the facts to corroborate or refute it. The statistical method must accept the irregularities of experience as it finds them. There can be no equal distribution of ignorance.

Judgments of chance, therefore, show no epistemological pecu-

[5] Laplace, *Theorie Analytique des Probabilites*, liv. II, Ch. I, no. 1.

[6] Edgworth, *The Philosophy of Chance*, Mind, N. S., Vol. IX (1884), p. 230.

liarity. Judgments of chance differ only in one respect from particular judgments of fact. They are judgments *about* propositions. Their subject matter is the relation of a certain proposition to certain other propositions. This is still within the realm of fact.

We may now ask specifically what is the meaning of the statement "that a proposition, p, has a probability, *P*." This will lead to the logic of chance.

The Logic of Chance.

There are two distinguishable varieties of chance: restricted chance and unrestricted chance. Another name for unrestricted chance is bare or antecedent probability.

On the Laplacian theory, bare probability is associated with complete ignorance. The philosopher who says that *a priori* all things are equally probable (or possible) has in mind unrestricted chance.

We may ask if a bare or unrestricted probability is not a contradiction in terms.

We have said that so long as experience is sufficiently coherent to present *things* or *events*, the statistical method can be applied. This is a condition, very general, to be sure, which experience must fulfill in order that chance may have any meaning. Before we can even speak of the antecedent probability of a thing or event, experience must give us things and events. Peirce says, on this point, that the application of the statistical method demands a universe with some character. "The presupposition of the determinate constitution of any set of facts such as are subject to inductive investigations is by no means a simple, not even a 'self-evident,' presupposition. . . . But the presupposition, as Peirce has shown, is the one natural and indispensable presupposition in all inductive science."[7]

It will be convenient to substitute for the terms *things* and *events*, the more general term, *propositions*. Propositions assert the existence of things or the occurrence of events.

The minimum condition, then, upon which any proposition can be barely probable is that it shall be at least a proposition, capable of truth or falsity. This is the meaning of Peirce's statement that chance demands a universe with a constitution.

[7] Royce, J., *Encyclopædia of the Philosophical Sciences*, edited by A. Ruge, Vol. I. p. 83.

We are here in contact with something equivalent to the logical universe of discourse. The widest context in which chance has a meaning is the world of any or all events, or the world of any or all propositions. Unrestricted chance is, therefore, chance under no special condition, but under the most general possible condition.

Specific statistical researches do not deal with antecedent probabilities. Statistics are always gathered within a limited field, i. e., a restricted universe of discourse. They are significant only upon the special conditions which hold within that universe. The *consistency* of a set of statistical propositions demands a strict adherence to the limiting conditions.

When the probability of a proposition depends, thus, upon the truth or falsity of some other specific proposition, we have a case of restricted chance. We shall call it "probability upon." It is in this form that probability is most familiar and useful. The probability of bad weather, for instance, is not a bare probability. It is not probability *in vacuo* under the widest possible conditions. It is based upon specific conditions: a certain degree of humidity, a certain velocity of wind, a certain geographical situation. Given other specific conditions, the probability will differ.

The difference between restricted and unrestricted probability may be summed up as follows: If a proposition, p, is probable upon a proposition, q, the latter is recognized as a special condition which must be considered before the probability of the former properly has a value other than its antecedent probability. On the other hand, the antecedent probability of the proposition, p, will depend upon no special condition. It will be the probability of p upon the most general conceivable condition, viz., simply that p is a proposition, true or false.

It is clear that the proposition which is probable upon another proposition stands in some sort of logical relation to it. This relation can not be the relation of formal implication, since any implied proposition can be strictly inferred from the proposition which implies it. A probable proposition can never be strictly inferred or predicted from its conditions. The relation is, however, like formal implication. It is a kind of *informal* implication. It takes the "if—then" form which is characteristic of implications.—"*If* certain atmospheric conditions are present, then probably bad weather will result."

The relation may be called *contingency*. The degree to which

one proposition or set of propositions is contingent upon another proposition or set of propositions is, in the first instance, the subject matter of judgments of probability.

It will be necessary to analyze the relation of contingency.

In logic the term proposition usually applies to a particular statement which is capable of truth or falsehood. We shall mean by a proposition what Mr. Russell calls an elementary proposition—"a proposition such as 'this is red' where 'this' is something given in sensation."[8] Thus, a proposition is true or false at some particular time and in some particular situation. But a proposition can be generalized so that what the proposition asserts is true or false at many different times and in many situations. If in place of "this is red" we assert "x is red," we obtain a whole series of elementary propositions by giving different values to the x.

Contingency is a relation between generalized propositions in which an undesignated or variable term appears. Consider the judgment, "If I am descended from a long-lived family, I shall probably be long-lived." The "I" is merely a particular value of an x; and the judgment remains the same when "anybody" or x is substituted for me.

There is a frequency with which the ambiguous proposition "x is descended from a long-lived family," will coincide in truth with "x is long-lived." This is the degree of contingency of the latter upon the former. The single coincidence of two elementary propositions is uninteresting and unimportant for the theory of chance. Such a coincidence would not give a degree of contingency. Degrees of contingency arise where there is a series of coincidences or failures of coincidence.

The generalized, or ambiguous proposition of which we spoke is a propositional function.[9] So that contingency is a relation between propositional functions.

The propositional function stands for a collection of propositions none of which is asserted. For the purpose of formal logic there are two ways of asserting a propositional function: (1) we may assert "ϕx always"; i. e., all propositions which are values of the function. This will be formal or universal assertion. (2) We may assert "ϕx sometimes"; which is tantamount to saying "there

[8] Whitehead and Russell, *Principia Mathematica*, Vol. I, pp. 95-96.

[9] Whitehead and Russell, *op. cit.*, p. 15.

exists a value for which the function is true." This will be a particular assertion.

Statistics deal with assertions which lie between the universal and the particular, and which are, in De Morgan's phrase, "numerically definite." For the purposes of statistics it must be possible to assert, "ϕx in n cases"; or "there exist n values for which the function is a true proposition." By means of this concept—"the n true propositions which are values of the function ϕx," where this totality is finite, probability and other statistical ideas can be given a strictly propositional interpretation.

The degree to which one propositional function is contigent upon another can be stated in numerically definite terms as follows: There exist n true values of a certain function, ϕx. There exist, also, m true values of the coincidence of this function with another function, ψx. The proportion m/n will measure the degree of contingency of ψx upon ϕx. (The conjunction or coincidence "ϕx and ψx" is itself a propositional function which, like any function, may be true for all values, for some values, or for m values.)[10]

This is exactly what we mean when we judge, "the probability is P that if x is descended from a long-lived family he will be long-lived." There are a number of cases in which it is true "that x is descended from long-lived family *and* x is long-lived." The proportion of these cases to all the cases in which it is true "that x is descended from a long-lived family" will be the degree of contingency of longevity upon descent from long-lived ancestors.

In general, then, the degree of contingency of one propositional function upon another will be determined by two existential propositions: (1) There exist m true values of the conjunction of the functions, and (2) there exist n true values of the conditioning function. We may look upon this "degree of contingency" as a relation, just as disjunction or implication is a relation. But we are dealing in this instance with more than a single relation. We have a class of relations. Wherever a ratio such as that just defined exists, the functions involved stand in a contingency relation. But for different cases we shall have different contingency relations, different degrees of contingency.

The contingency relation will be a formal relation. It will hold for all values of the variable. Thus, in the example given

[10] The case in which either n or m is infinite is not included in the definition. It is essential that they be finite numbers, since a ratio with an infinite term has no numerical interpretation applicable to the concept of probability.

above, whatever value x assumes, the relation will still be the same between longevity and descent from a long-lived family.

It is because contingency is a formal relation that any two elementary propositions which are values of contingent propositional functions can be said to be contingent. "What holds of *all* holds of any." This is a primitive proposition of logic. So, if "John Smith" be substituted for x in the example just given, it will be true that the particular proposition "John Smith will be long-lived" will be contingent in the degree P upon the particular condition "John Smith is descended from a long-lived family." We have said above that such a judgment does not commit us to stating the truth or falsity of either of these two elementary propositions. They may both be utterly false. John Smith may be a saw-dust doll, who has neither ancestors or life. That will not invalidate the judgment of probability, for the judgment says that "*if* John Smith were descended from a long-lived family he would be long-lived in all probability."

It is now clear what is the subject matter of judgments of chance. They affirm that a certain formal relation of contingency subsists between propositional functions. They are to be classed with the hypothetical judgments of traditional logic, which assert the subsistence of the relation of formal implication.

How does the formal relation of contingency appear in cases of unrestricted or antecedent probability? There the probability depends only on the most general condition: that the proposition in question *is* a proposition, capable of truth and falsity. It depends upon the general state of the universe. The antecedent probability of a proposition will be the ratio of all true values of the propositional function, of which the proposition in question is a value, to all values of the function, both true and false. Thus, the antecedent probability of "x will die" will be the proportion of all cases in which this is true to all cases in which it could be either true or false. This will be its degree of contingency upon its mere subsistence as a proposition in the widest possible universe of discourse. Antecedent probability, can, therefore, be defined in terms of restricted probability or "probability upon." It is probability upon the unrestricted universe of discourse.

Much complexity may appear in the chance relations of propositions. So far we have spoken only of the contingency of one proposition upon another. The conditions upon which a proposi-

tion is contingent may be many. Similarly, the contingent proposition may be, not a single proposition, but a complex system of propositions. As a simple illustration, consider life insurance. The conditions upon which life is dependent are not health alone, but also age, occupation, residence, etc., and each of these has a different weight. A weather forecast usually states a system of probable events, as "changing winds from the north-west or north, light clouds and a falling temperature."

Judgments of chance deal, for the most part, with contingency relations between systems of propositions. These systems are complex logical combinations of propositions. The laws of all possible combinations are the laws of chance.

There are three important phases of the relation of contingency of which we have not yet spoken: (1) favorable contingency, (2) unfavorable contingency, and (3) independence.

The following is a general illustration of these three concepts. The chances that I will be killed in war are, let us say, two to one. If my duties keep me in an *abri* thirty feet underground, this will increase the probability of my survival and decrease the probability of my death. It will be favorable to the one and unfavorable to the other. Suppose that there are no *abris* thirty feet deep, that the *abris* are as unsafe as any other place of duty. In this case the probability of my survival will be independent of whether my duty places me in an *abri*.

The distinction between antecedent and restricted probabilities must be considered in this connection. The favorable or unfavorable effect of additional conditions will always be relative to the original conditions of a probability. A condition which is favorable under one set of original circumstances might be unfavorable under another set. Independence is similarly affected by the original conditions. Thus, the probability that I would vote the Republican ticket, if I lived in Massachusetts, might be increased if the Democrats threatened the woolen industry by lowering the tariff. On a different original condition, say that I live in Georgia, the attitude of the Democratic party on the tariff might have the opposite effect on the probability of my voting the Republican ticket.

In cases of restricted probability, additional conditions are therefore *relatively* favorable to, unfavorable to, or independent of, the probability in question.

In the case of unrestricted probability, an additional condition

which altered the probability could be said to be *absolutely* favorable or unfavorable. An additional condition which left the probability the same would be *absolutely* independent. Thus, for Leibniz, all worlds were *a priori* equally probable. But the goodness of this world was a condition which was absolutely favorable to it, because it increased its antecedent probability.

Summary.

The results of our examination of the concept of chance may be summarized as follows:

The definition of chance does not involve the metaphysical question of determinism. Both chance and necessity appear in the world of experience. Necessity appears when we make generalizations which hold without exception; chance appears when we make generalizations which hold in a proportion of the cases which they cover, i. e., statistical generalizations.

The statistical method is useful (1) because certain facts are such that no strict generalizations (i. e., generalizations without exceptions) can be made about them. (2) The statistical method has utility, also, as a means of dealing with large masses of things and events of which we wish to know the average or general behavior. The utility of the statistical method does not depend on human ignorance.

Judgments of chance are judgments of fact. Their subject matter is a frequency of truth within a class of propositions. Chance is therefore objective and is not created by belief. The equal distribution of ignorance, which is the basis of the Laplacian theory, is inadmissible.

Chance shows two major varieties: (1) unrestricted, and (2) restricted. Restricted chance, or probability upon certain conditions, is fundamental, and in terms of it the unrestricted or antecedent probability can be defined.

Restricted probability, or "probability upon," is a character which propositions acquire by being in the contingency relation to some other proposition or set of propositions. The contingency relation is a formal relation which subsists between propositional functions. Hence judgments of chance are like the traditional hypothetical judgments of logic: they assert a formal relation. The laws of chance show all the possible ways in which this contingency relation may be combined with the other logical relations.

It remains to set down in systematic form some of the most important propositions of the logic of chance.

Symbols:

The symbols p, q, r, s, etc., will stand for propositions.

By 'p,' 'q,' 'r,' 's,' etc., we shall mean all true values of some propositional function ϕx, ψx, etc., of which p, q, r, s, etc., are values. This must always be a finite number. The symbol 'p' can be read eliptically "all cases of p true." (When it is written '$p \,.\, q$,' or '$p \,.v.\, q$' it means all true cases of the whole expression included in the single quotation marks.)

The contingency relation will be symbolized by the mark, /. So that p/q will mean the probability of p upon q.

Other logical relations will be symbolized by the conventional signs. Disjunction by, v; conjunction by a dot, .; negation by, $\backsim$.

Definition of probability.

The probability of p upon q is the ratio of all true cases of p and q to all true cases of q.

$$p/q = \frac{\text{`}p.q\text{'}}{\text{`}q\text{'}} .$$

Definition of relative independence.

When the probability of p upon q is equal to the probability of p upon q and r, then p is independent of r with respect to q.

$p/q = p/q \,.\, r$ means p is independent of r with respect to the condition q.

The converse is true: that if p is independent of r with respect to q, r is independent of p with respect to q. The relation of independence is symmetrical. (Proved by means of the definition of probability.)

Relative favorable and unfavorable dependence.

If the probability of p upon q and r is greater than the probability of p upon q, then p is favorably contingent upon r with respect to q.

$p/q \,.\, r > p/q$ means p is favorably contingent on r with respect to q.

If the probability of p upon q and r is less than the probability of p upon q, then p is unfavorably contingent upon r with respect to q.

$p/q \,.\, r < p/q$ means p is unfavorably contingent upon r with respect to q.

Definition of antecedent probability.

The *antecedent probability* of p is its probability upon the condition, p, or not-p.

$p/p \,.\mathrm{v}.\, \sim p$. is the antecedent probability of p.

(The condition p or not-p completely exhausts the universe of discourse; it is the widest possible condition upon which p can be probable.)

Absolute independence, and absolutely favorable and unfavorable dependence.

If the probability of p upon q is equal to the antecedent probability of p, P is absolutely independent of q. In this case, $p/p \,.\mathrm{v}.\sim p = p/q$.

If the probability of p upon q is greater than the antecedent probability of p, then p is absolutely favorably dependent upon q. In this case, $p/q > p/p \,.\mathrm{v}.\sim p$. If $p/q < p/p \,.\mathrm{v}.\sim p$, then p is absolutely unfavorably dependent upon q.

Multiplication of probabilities:

The product of two independent probabilities is the probability of the joint contingency of the two propositions upon their joint conditions. This can be stated more specifically as follows:

If p/q is independent of $r \,.\, s$, and r/s is independent of q, then $p/q \times r/s = p \,.\, r/q \,.\, s$.

Proof:

Since p/q is independent of $r \,.\, s$, and r/s is independent of q, therefore $p/q = p/q.r.s$, and $r/s = r/s \,.\, q$. (By definition of independence.)

Therefore: $p/q \times r/s = p/q.r.s \times r/s \,.\, q$

$$= \frac{`p.q.r.s'}{`q.r.s'} \times \frac{`r.s.q'}{`s.q'}$$ (By definition of probability.

$$= \frac{`p.q.r.s'}{`s.q'}$$ (By cancellation.

$= p \,.\, r/s \,.\, q$ (By definition of probability.

This is the most general rule for the multiplication of probabilities. Its more familiar and special form is:

The product of the probabilities of two independent propositions is the probability of their joint truth:

$p/q \times r/q = p \,.\, r/q$ where p is independent of r with respect to q.

Addition of probabilities:

The sum of the probabilities of two exclusive propositions is the probability that either one or the other is true.

If the propositional functions, of which p and q are values, are mutually exclusive, then $p/q + r/q = p \;.\mathbf{v}.\; r/q$.

The proof of this proposition requires an assumption which we may call the *principle of addition*. This assumption is: If ϕx and ψx, of which p and q are values, are mutually exclusive, then '$p \;.\mathbf{v}.\; q$' $=$'p' $\times$ 'q' ; which means that all cases of p or q true are equivalent to all cases of p true plus all cases of q true.

The proof of the rule for adding probabilities then becomes:

$$p/q + r/q = \frac{`p \,.\, q'}{`q'} + \frac{`r \,.\, q'}{`q'} \qquad \begin{matrix}\text{(By definition}\\ \text{(of probability.}\end{matrix}$$

$$= \frac{`p \,.\, q' + `r \,.\, q'}{`q'} = \frac{`p.q \;.\mathbf{v}.\; r.q'}{`q'} \qquad \begin{matrix}\text{(By principle of}\\ \text{(addition.}\end{matrix}$$

$$= \frac{`q \;(p \;.\mathbf{v}.\; r)'}{`q'} \qquad \text{(By the distributive law of formal logic.}$$

$$= p \;.\mathbf{v}.\; r/q \qquad \text{(By definition of probability.}$$

The rules for the addition and multiplication of probabilities are the two most important laws of chance. Multiplication, as shown above, depends upon the definition of probability and the definition of independence. Addition requires a postulate: that the sum of the true values of two exclusive propositional functions is equal to all true values of their disjunction. Addition and multiplication, together with the definitions of independence and antecedent probability, give the material for a complete logic of chance.

RALPH M. EATON.

CAMBRIDGE, MASS.

"RECONSTRUCTION IN PHILOSOPHY."

This book contains a series of lectures delivered by Prof. John Dewey in the Imperial University of Japan.

As the title indicates, the aim of the lectures is to reconstruct philosophy. The development of philosophy, according to Professor Dewey, has not proceeded along correct lines. There has been bad aim and waste in effort.

The point of view from which philosophy is to be reconstructed is that of pragmatism. That is, the development of knowledge is to proceed along the lines of willing rather than of knowing. Being interested in logic, I wish to examine Professor Dewey's doctrine of logic. This is contained in Chapter VI of the book and is termed, "The Significance of Logical Reconstruction."

The teaching of the chapter is based upon the view of knowledge given in Chapter IV, "Changed Conceptions of Experience and Reason." Hence we begin with this chapter.

In this chapter Professor Dewey works out to the conclusion, "Thinking is the way in which deliberate reorganization of experience is secured." The teaching of John Locke is not correct. Knowledge does not begin in sensation. "The senses lose their place as the gateways of knowledge to take their rightful place as stimuli to action." A sensation is "urgent not cognitive in quality." "Knowledge is relegated to a derived position, secondary in origin." Prof. Dewey attributes this change of view to biology. "The effect of the development of biology has been to reverse the picture. Wherever there is life, there is behavior, activity. In order that life may persist, this activity has to be both continuous and adapted to the environment." "Wherever there is life, there is behavior, activity." That is, the ultimate is life, and life is active. "Even a clam acts upon the environment and modifies it to some extent. It does something to the environment as well as has something done to itself." I do not know what value the reader will attach to the contradiction in Professor Dewey's statement. The ultimate is life and life is activity. Yet this activity must be continuous. Not only is a must associated with this ultimate, but this must requires continuity. Continuity is not change; it is not action. It is the opposite of action. Continuity is identity that persists in and through

change. Not only must there be continuity but the activity must be "adapted to the environment." Whatever "adapted may mean, it surely cannot mean change. It is therefore interesting that Professor Dewey contradicts his doctrine in stating it. That is, Professor Dewey's explanation fails to consider the full content. The ultimate is action, yet in this ultimate action there is present that which does not act, in fact resisting all action. If the statement, "A sensation is urgent not cognitive in quality," is examined, it seems impossible to follow Professor Dewey.

Look at the figure 4, you get a clear, definite, complete percept. Examine this state of consciousness as you will, you do not detect any pull or push. The four has no connections. It is a concept in the sphere of quantity and is ultimate. It is pure. That is, it gives no evidence of dependence upon something different; nor does it produce any other. To me it is utterly without any "urge." A student once said that the four was made of apples. Two apples and two more apples would make four. The teacher accepted the challenge and ordered a barrel of apples. The task was to get a four. The class became industrious and excited. One man secured apple sauce; another got cider; another secured float. The failure to secure a four was complete.

There are sensations that excite emotions that lead to action; but many do not. An engine standing upon a beautiful road-bed with shining steel rails does not have the impulse to move. The impulse to move has its source in the boiler, not in the head-light. If we take a case of knowledge upon a higher level, say a bit of analysis by a scientist, we are unable to see the urgency. A chemist has a specimen of water. He wishes to know its structure and makes an analysis. Here is an emotion, a desire for knowledge, then the action of the analysis, then the knowledge. The action is well done, the knowledge is correct. This knowledge, water is H20, does not have the quality of urgency, but rather the opposite. It is a state of satisfaction, an end of action, a state of peace and rest.

Pragmatism is able to give an account of action on the level of quantity; but it fails in questions of quality. Take the case of wheat. We plant a grain and get a harvest of twenty grains. Here is a gain of nineteen grains. Pragmatism appears to offer the best explanation of these nineteen grains. There has been no change in quality. In each of the twenty grains is the identical quality. In fact if any change appears in any one of the grains, then some thing other

than the action of the original grain is brought in as explanation. "Accidental variation" or some other meaningless phrase is invoked. The fact is, pragmatism fails at this point. The absence of change in quality is as important to pragmatism as the presence of change of quantity.

Pragmatism fails utterly on the level of finished and complete knowledge. I suppose it will be admitted that the multiplication table offers a piece of finished and perfect knowledge. We can know its life for at least three thousand years. During this period there has not been the slightest suggestion of any change of any kind. It is literally the same yesterday, to-day and forever. My mind refuses to entertain any possible change in this table. This characteristic of the table is not a peculiarity of the table. It is seen in the table because the table is an example of finished truth. Any body of knowledge has illustration of this mark of truth. In fact I do not see how it would be possible to develop a body of knowledge, if there were no fixed and dependable parts. Activity seems to belong to the unfinished, the incomplete, the young. When the truth is seen, what else is there? When a problem is solved, or a difficulty mastered, it seems impossible to act further. Change would appear in the effort to get the truth. The errors made in this effort are no part of the truth. The effort and the error cease with the knowledge. This brief sketch will show that we are unable to follow Professor Dewey in his doctrine of the place and function of knowledge. The statement is not adequate.

We now proceed to consider the doctrine in the chapter. "The Significance of Logical Reconstruction."

Professor Dewey begins his statement with a complaint as to the sad condition of logical theory. There is no agreement as to the aim, the method or the content of logic. "Logical theory presents a scene of chaos." "These contrarieties are so numerous, so extensive, and so irreconcilable that they are ludicrous." This scandalous condition is to be removed in the reconstruction submitted by Pragmatism.

It is admitted that logical theory does not present uniformity in method nor identity of content. Absolute uniformity is found in two spheres. One is the cemetery; the other is in fashion. If one wishes to establish citizenship in a cemetery, there is one thing to do. But if one wishes to be a rose, he has a choice. If one wishes to be a fish, his option ranges from a sucker to a whale. If

he wishes to be a logician, the range is still wider. Form is uniform; life is not. The richer the life, the wider the variety. Hence if logic is to deal with form, with the dead, we may expect uniformity. If it is to deal with life, we may expect exciting forms of variety. Professor Dewey says the variety amounts to chaos. I do not believe in chaos anywhere and so I take Professor Dewey as authority for abundant variety in the sphere of logical theory. This should indicate that logic, whatever it may be, is a living thing.

This brings us to the question, what is logic?

Professor Dewey says, "If thought or intelligence is the means of intentional reconstruction of experience, then logic, as an account of the procedure of thought is not purely formal." "Logic is a clarified and systematized formulation of the procedures of thinking as will enable the desired reconstruction to go more economically and efficiently. In language familiar to students, logic is both a science and an art; a science so far as it gives an organized and tested descriptive account of the way in which thought actually goes on; an art, so far as on the basis of this description it projects methods by which future thinking shall take advantage of the operations that lead to success and avoid those which result in failure."

The phrase "organized and tested descriptive account of the way in which thought actually goes on" sounds interesting. But when Professor Dewey comes to interpret his meaning, we are disappointed. "Out of this relationship of cause and effect as it is empirically ascertained grow the norms and regulations of an art of thinking." "The structure of alleged normative apriori mathematics is in truth the crowned result of ages of toilsome experience." "Logic is a matter of profound human importance precisely because it is empirically founded and experimentally applied." "Men began with counting and measuring things just as they began with pounding and burning them."

It is not fair to take a few sentences from a lecture and judge the lecture by them. Yet I think the purpose of the lecture is to show that truth has its source in action. The ultimate is not truth, but action. If this dictum of Professor Dewey stands, his purpose to clear the field of logic of variety will fail. He adds to the menagerie. It is this dictum that I wish to consider. I admit at once that truth works. It is the only thing that does work satisfactorily. That is, the man who has a clear concept of an engine

can build one. But I am unable to find a case of pure action. Galileo discovered a law mixed in the action of the rock that fell from the tower of Pisa. Heraclitus could not state his theory of universal motion without contradicting it with his doctrine of logos. Buddhism made an effort to state an ultimate condition of change and contradicted this statement in its doctrine of Karma. The doctrine of Professor Dewey is not new. Nor does he avoid the rock upon which his predecessors floundered. "Organized and tested" do not suggest ultimate action or change. Any change would be fatal to a "Test." The process of measuring cloth can not serve as a test of the yardstick. Perhaps an illustration will clear the matter. A man wishes to grow corn. He proceeds to indulge in the process of growing corn. He plows and harrows, harrows and plows, and in due time a grain of corn is produced. My contention is that the grain of corn is apriori to the process of growing corn. The grain must preceed, not follow the process of growing corn. The cultivation will affect the quantity of corn, but does not generate the corn. The sphere of pragmatism is the sphere of quantity. Action as a simple, ultimate concept is a contradiction.

With an inadequate view of sensation and a contradictory view of action, it is to be expected that the account of the beginning of thinking and the range of thinking will be unsatisfactory. Indeed, to one who loves the process of thinking and marvels at its range and power and richness, this part of the discussion is especially disappointing.

"Thinking," says Professor Dewey begins in trouble. "Men do not in their natural estate, think when they have no trouble to cope with, no difficulties to overcome." "Beings who think are beings whose life is so hemmed in and restricted that they cannot directly carry through a course of action to victorious consummation." Later in this paragraph Professor Dewey makes this admission, "Difficulties occasion thinking only when thinking is the imperative or urgent way out." That is, in an ideal condition of life there would be no thinking. It follows that the best thinking takes place in hell. Under these conditions what is an unfortunate philosopher to do? But the case is worse still. Only some difficulties are to be relieved by thinking. There is competition. "Dreams, reveries, emotional idealizations are roads which are taken to escape the strain of perplexity and doubt." To this sad estate has our American philosopher reduced thinking. It is in business with dreams, reveries,

and emotional idealizations. And we are to expect this view of thinking to reconstruct logic and lead us out into the open.

I have wondered if Professor Dewey has not confused *Verstand* and *Vernunft*? To handle a difficulty is first a matter of analysis. What is it? What is its cause? What will be the effect? These are questions of analysis and classification and involve the process of *Verstand*. The *Vernunft* is not directly involved in these. The sphere of thinking is not difficulties, but truth. Thinking has its source in the passion for truth. Difficulty is a hindrance, a limitation; thinking is a transcendence. Animals have their share of difficulties; but they do not think.

The thinker has his problems; but they are not defects of memory, or illusions of the senses, or the difficulties of faulty analysis and judgment. They are problems of thinking. That is, they arise in the development of thought. They spring out of growth, development, rather than out of misfortunes. They are solved by thinking only; never by any rhapsodical treatment. An example of what I mean is found in mathematics. When the student begins Algebra he comes upon the process of multiplying signs. Plus by plus gives plus. Minus by minus ought to give minus, but it does not. It gives plus. How? If the student will understand this, he must get busy. Where does the plus come in when you are dealing with two minus quantities? Only the one who thinks can answer this question. This is a genuine problem arising logically in the development of mathematics. If you study, these problems will arise. If you absorb them, you must think. The only way to escape the problems of intelligence, is not to be intelligent. If a student passes out of the static philosophy into the dynamic philosophy he will face the problem of the miracle. There is no escape. The problem lies in the journey. Only the intelligence that avoids all prodigal journeys escapes the problems of travel.

Then why does one think? Not to avoid a difficulty, but to express life. Thinking is positive, constructive, the full expression of life. Thinking is not the product of troubles; it is free and logical. That is, it unfolds from within. Nothing but the truth controls the thinker. No error has been able to live in the light of truth. As a boy I made an effort to see seven times eight as fifty five. When I saw it as fifty six, it was impossible to consider fifty five. The mind would not take hold. Thinking is not accident, nor the product of custom, nor the outcome of trouble.

or the "easiest way to do a thing." The apple tree true to itself ears apples; a thinker true to thinking is logical. And so I am sure Professor Dewey is in error when he says, "To perceive this fact s to abolish rigid dogma from the world." We may abolish the wrong use of dogma. This is being done. We may abolish the process of substituting pictures, names, hopes for dogmas. But a genuine dogma properly understood is as essential as civilization.

What then is thinking? To answer this question means a course of lectures running through a year. It is beyond the scope of a criticism of one lecture. But one may indicate the line of answer. To think is to explore variety in search of that unity we call truth. Most of our impulses are separating forces. The senses tear their facts from larger wholes. Geometry fixes these parts as final, unchanging units. A right angle triangle never changes into anything else. Grand divisions are thus introduced into life, a kind of philosophical aristocracy. Man finds himself in this disjointed, lonely world.

It is the thinker who meets and checks these disintegrating forces. The ancient Hindoo thinker saw reality as unity, one supreme unity, Brahma. He likened the process of thinking to the action of the drop of water, resting not until it is back into the bosom of the ocean. Because the drop is water it seeks its own, the ocean. So thinking, because reality is unity, seeks unity which is truth. The Upanishads give brilliant illustration of thinking. By thinking the Hindoo lifts himself out of the bonds of the physical and lives forever in the world of truth. Here we see clearly the constructive, expanding, ennobling work of thinking.

The positive, constructive work of thinking is seen perhaps more clearly in Plato and Aristotle. These added the ideal world to Greek life. It was through the work of Plato and Aristotle that the Athenean ceased to compete with Sparta and became the leader of European civilization. The marvelous careers of Alexander, Augustine, Innocent III, are possible because of Plato and Aristotle.

If you object to these illustrations as too theoretical, then reflect upon the thinking of Maxwell. This thinker considers the square root of minus one and uncovers the possibility of wireless telegraphy. Here is genuine service of most practical kind. Or take the work of Pupin studying fundamental functions and giving to the world long distance telephoning. These examples of thinking show something of the nature of thinking. It is constructive and expanding.

If you protest that these are supreme cases, I agree and reply that if you would know an apple, you would not limit your study to the bloom or the little green thing that gives boys colic. You would surely take the mature sample. If you would observe the land, ascend the highest mountain peak and feast your eyes, do not go into some hole in the valley and then say life is just bumping against environment.

The world to-day seems to be short of great leaders. I have wondered whether the philosophers were not to blame. They have been giving us such little, superficial views. There is no depth to life, no reach to vision, just environment. Let us have done with kindergarten views of the nobler qualities of man. Let us invoke the spirit of Spinoza and restate our doctrine of the Absolute One that Spinoza knew as Substance. Let us invoke the spirit of Kant and renew our faith in man, in his moral nature and obedience to the categorical imperative. And then we shall be prepared to invoke the spirit of the supreme philosopher and see reality as Spirit. Then we shall see in its fulness what it is to think.

H. H. WILLIAMS.

UNIVERSITY OF NORTH CAROLINA.

ON CERTAIN SUPPOSED FALLACIES OF THE CLASSICAL LOGIC.

No experience is more familiar to the mathematician than the need of extending the primitive meaning of his concepts, so as to include cases not previously suspected. Such extensions of meaning of the mathematician's assumed indefinables or of his symbols of relationship are of the greatest importance. They are only possible to the trained imagination and represent always the most serious obstacles in the learner's progress toward his goal. The mind, which has been only partly trained to follow the paths of scientific rigor, tends to fall back upon its more familiar points of view. It struggles to grasp the new, without yielding up the old conception.

If the mathematician has kept his secrets, as did his early ancestor, the Pythagorean of old, it is chiefly because these secrets

have managed to keep themselves. But the distinction between the learner and the learned is, like most distinctions, a relative one. The non-mathematical logician will follow the results which this paper presents to the point, where the demand is made that our implications shall remain true for all meanings of the terms—in particular, when any two terms have been identified. At this point an extension of the meaning of implication will be required and he will drop out of the company of our readers. The mathematical logician, being thus left to go the rest of the way alone, we shall employ the transformations of the class calculus without further explanation. Very soon, however, it will become necessary to extend the meaning of our propositional functions and some of our readers will again be lost to us. Let us hope that a few will find their way through to the end.

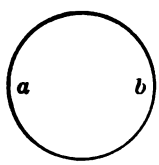
The four propositional functions, which we shall have to employ, will be abbreviated as follows. Let

$$\alpha\ (ab) = \text{All } a \text{ is all b},$$
$$\beta\ (ab) = \text{Some } a \text{ is some } b,$$
$$\gamma\ (ab) = \text{All } a \text{ is some } b,$$
$$\epsilon\ (ab) = \text{No } a \text{ is } b,$$

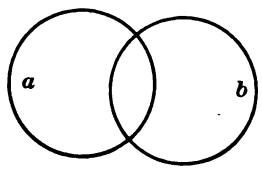
a and b standing for class-terms and the word *some* being interpreted to mean *some at least, not all.*

In order to attach a *preliminary* meaning to these forms, let us employ the geometrical analogy invented by Euler. Our four propositions would then be rendered by the diagrams given below.

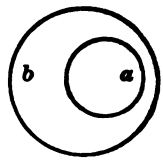
All a is all b



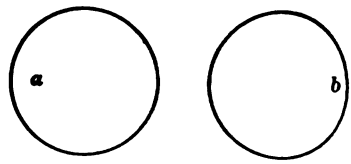
Some a is some b



All a is some b



No a is b



Because they possess similar properties, it is the custom to represent *inclusion* and *implication*—just as the negation of a class and the denial of a proposition—by the same sign, i. e.,

$$a \angle b = a \text{ is included in } b,$$
$$a \angle b' = a \text{ is included in non-b},$$
$$(a \angle b)' = a \text{ is not included in } b, \text{ etc.}$$

Suppose that we should wish to express the propositional functions, α, β, γ and ϵ in the forms that are ordinarily employed. It would then seem natural to recognize the following identities (the multiplication sign, understood but not expressed, between the brackets, standing for the word *and*):

$$\alpha \ (ab) = (a \angle b) \ (b \angle a),$$
$$\beta \ (ab) = (a \angle b)' \ (b \angle a)' \ (a \angle b')',$$
$$\gamma \ (ab) = (a \angle b) \ (b \angle a)',$$
$$\epsilon \ (ab) = (a \angle b').$$

We might then inquire if these representations verify all of the implications, which the traditional logic would set down as true. In order to make this verification complete, it would be enough to deduce the characteristic inferences of the system by means of the transformations of the class calculus. Thus we should have:

$$(1) \ (c \angle b) \ (b \angle a) \angle (c \angle a),$$
$$(2) \ (a \angle b) \ (b \angle c) \angle (a \angle c).$$

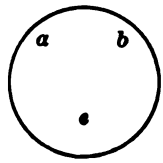
Multiplying together both sides of (1) and (2) and rearranging the factors conjoined in the antecedents,

$$\{(b \angle a)\ (a \angle b)\}\ \{(c \angle b)\ (b \angle c)\} \angle \{(c \angle a)\ (a \angle c)\}$$

and this by definition would be the same as

$$a\,(ba)\ a\,(cb) \angle a\,(ca)$$

(see fig. below)



But it would soon be discovered that some of the implications, that would normally be recognized as valid, break down. Thus, we should expect to have

$$\gamma\,(ab)\ \epsilon\,(ab) \angle o,$$

(the symbol, o, standing for the *null*-proposition) and this would be rendered by

$$(a \angle b)\ (b \angle a)'\ (a \angle b') \angle o,$$
$$\text{or } (a \angle b)\ (a \angle b') \angle (b \angle a)$$

and this result is manifestly not true in general.

Early in the development of the class calculus fallacies similar to the one just noticed were pointed out among the implications of the common logic and it has been the habit of logicians to assert that the relationship of subalternation and some of the valid moods of the syllogism break down. This misapprehension—for it will turn out to be such—is all but universally shared by recent writers. Its removal may be effected by a solution similar to the one which follows.

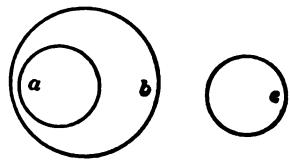
Our rendering of the four propositional functions has been *over-simplified.* Let us attach to them, not the meaning which they had above and which has proven insufficient, but the one which follows, viz.,[1]

[1] For the suggestion which led to this solution I am indebted to Prof. E. A. Singer, Jr. See the article, *Note on the Relation of Subalternation*, in the *Journal of Philosophy*, Sept. 11, 1919.

$$\alpha\ (ab) = (a \angle b)\ (b \angle a),$$
$$\beta\ (ab) = (a \angle b)'\,(b \angle a)'\,(a \angle b')'$$
$$\gamma\ (ab) = (a \angle b)'\,(b \angle a)'\,(A' + B),$$
$$\epsilon\ (ab) = (a \angle b')A'B'$$

where $A = a \angle a'$ and $B = b \angle b'$.

Consider the syllogism, $\gamma\,(ab)\,\epsilon\,(cb) \angle \epsilon\,(ca)$, see fig. below)



We have

$$(1)\ (b \angle a)'B'A'C' \angle A'C',$$
$$(2)\ (a \angle b)\ (b \angle c') \angle (a \angle c')$$

Multiplying together both sides of (1) and (2), factoring and strengthening the antecedent, and remembering that

$$(A' + B)B'C' \angle A'C',$$

there results

$$(a \angle b)\ (b \angle a)'\,(A' + B)\ (b \angle c')B'C' \angle (a \angle c)A'C',$$
$$\text{or } \gamma\,(ab)\,\epsilon\,(cb) \angle \epsilon\,(ca).$$

since

$$(b \angle c') = (c \angle b') \text{ and } (a \angle c') = (c \angle a').$$

It will be easy to see that the characteristic features of the system, which the common logic would recognize (a system whose implications might be verified empirically by the aid of Euler's diagrams), are now retained.

It must be observed, however, that the interpretation of our four propositional functions, which has just been given, is not unique. All of the implications of the same logic will hold, if the following meaning were to be assigned to the four forms.

$$\alpha\ (ab) = (a \angle b)\ (b \angle a)\ (AB + A'B'),$$
$$\beta\ (ab) = (a \angle b)'\,(b \angle a)'\,\{(a \angle b')' + (A + B)\},$$
$$\gamma\ (ab) = (a \angle b)\ \{(b \angle a)'\,(A' + B) + A'B\},$$
$$\epsilon\ (ab) = (a \angle b')\,A'B'.$$

Let one further illustration suffice:

$$(1)\quad A'B'C'(a\angle b)'(c\angle b)'\angle B'$$
$$(2)\quad (b\angle a)\,(a\angle c')\,(b\angle c)\angle B$$

Multiplying together (1) and (2),

$$\begin{aligned}&(b\angle a)\,(a\angle c')\,(b\angle c)\,(a\angle b)'(c\angle b)'A'B'C'\angle o,\\ \text{or}\ &(b\angle a)\,\{(a\angle b)'\,(A+B')+AB'\}\\ &(b\angle c)\,\{(c\angle b)'(C+B')+CB'\}\\ &(a\angle c')A'C'\angle o,\end{aligned}$$

and this by definition is the same as

$$\begin{aligned}&\gamma\,(ba)\,\gamma\,(bc)\,\epsilon\,(ca)\angle o,\\ \text{or}\ &\gamma\,(ba)\,\gamma\,(bc)\angle\epsilon'\,(ca).^{2}\end{aligned}$$

Our conclusion may now be briefly stated. In translating the categorical forms of the ordinary logic into the forms of inclusion of the class calculus, we must be careful that our rendering shall not be over-simplified and as a result some of the varieties of immediate inference and of the syllogism be mistakenly regarded as fallacious. A rendering of the propositional functions of the traditional logic is possible, which will allow all of the implications of that logic to remain true without any restriction whatever being imposed upon the meaning of the terms.

HENRY BRADFORD SMITH.

UNIVERSITY OF PENNSYLVANIA.

[2] This mood of the syllogism has been selected for illustration because of its analogy with *Darapti*, a mood ordinarily regarded as fallacious (See, for example, Bertrand Russell's *Introduction to Mathematical Philosophy*, p. 164).

THE SONG OF FIRE.

I.

A monster came with lightning's loud applause
And seized upon the forests unafraid,
Devouring them with laughing unseen jaws
And breathing fiery smoky breath which laid
Its blackened mark on everything it swayed
Or touched. And infant Man beheld in fear
The beast which came from angry gods severe.
He fled in pain before its unseen blade
And licked the wound which it so strangely made.
He crouched to see the thunder-storm appear.
He fled the mountains whence such monsters rise
In power for mad destruction's wild career.
What memory a dawning mind supplies
But makes more strong this fear which terrifies.

II.

In time Man's wish for knowledge overpowered
The awe and dread which held his soul enchained
In terror's pain before the flame which towered
Above or swept along the forest stained;
Its sense of play in time his heart regained.
He added fuel to the fire for fun!
And began a lesson which is not yet done.
He found the softening comfort fire maintained;
What once was terror he to joy constrained.
No beast has ever found this skill. Not one
Has learned to keep a fire. But Man withdrew
Its fangs and taught it to his work to run.
By aid of fire Man spread to regions new,
Foretelling he the earth should yet subdue.

III.

With mastery of zealous fire began
Controls of nature's varied powers which raise

Our hopes and prophesy the growth of Man.
'Tis put to use in many thousand ways;
Its power lightens work of busy days.
It brings to view what nature never made,
Now wrested from her by the hand which laid
With skill the power of fire upon her maze,
Demanding truth of Nature who obeys.
Whatever law is found or truth portrayed
But calls for other mastery and higher;
To spiral heights we climb by conquest's aid.
As Man still grows so grows the use of fire
To meet his wish and rally his desire.

IV.

The first fireplace kept up by thoughtful Man
A meeting place for many friends became.
The memories which clustered there began
To draw together strength and human aim,
And Man with zeal and purpose new inflame.
They knit together forces which entwined
The cords of love round hearts of humankind.
They brought the common goods to wide acclaim,
And Man learned how his ruder strength to tame.
Henceforth a place to Man shall be assigned
As one whose wondrous labors far excel
Whate'er can come, by one alone designed;
And fire shall mix with all that Man shall tell
Of things in earth or things in heaven or hell.

V.

Know you that life which proudly moves in you
And fire which lives and glows are one, with the same
Glad power and sources whence that power they drew?
That breath of life is but the breath of flame?
That this the spirit's power doth proclaim?
And Man is but a fire now hid in clay
Which yet again shall flame some happy day
When genius brings, to justify its fame,
A novel conquest Man shall joy to acclaim?
Could Man be Man without the fire's assay,

The fire of genial spirit to aspire,
The fire of truth to melt his dross away?
Could Man be Man without the use of fire
Which wildly burns with flaming wild desire?

VI.

When a tribe outgrew its central fire or ranged
Too widely o'er the fields to well command
The benefits which grew from thoughts exchanged
Around the fire, those leaving took a brand
And made with it a fire in their new land.
Without intending it, they took away,
Besides the fire they purposed to convey,
A part of all the best the tribe had planned
And those still greater goods none understand,
Spontaneous truth which grows without display
And the spirit binding soul to kindred soul.
The kinship early felt still holds its sway;
The truth and life which early rose control
The unitary progress of the whole.

VII.

When a man and woman went to live apart
Their family grew around their genial fire,
And thus were bound their children heart to heart.
Here first they learned for wisdom to inquire.
Here first glad nature taught them to aspire.
Here grew the strongest tie that Man has known,
The sacred tie which binds him to his own.
Should family fire on unkept hearth expire
A fatal famine comes and danger dire.
The household sun which ages long has shone
Must light the life of all the family race,
Transmitting what of good in it has grown.
Ancestral spirits dwell in the loved hearth-place;
Their life with childhood's growth they interlace.

VIII.

Around the central hearthstone clustered life's
Intenser joys, and Man lived here erect

In presence of himself, apart from strifes.
Whatever worth life taught him to expect
In character its strength did here project.
The silent hour before the ember's glow
Brought aspiration's zeal to overflow.
Whatever wish his purpose might reflect
Here wrought with power upon his intellect.
His brooding spirit, but short time ago
Submerged beneath the action of the day,
Now found its opportunity to grow.
In silent thought his inner life could sway
His deeper self through powers which came to stay.

IX.

Not always pleasant was his fireside thought.
An ominous accuser sometimes came.
The pain his actions gave to others brought
A pain to him; he felt a sense of shame;
He felt a power his wickedness proclaim.
Incipient sense of right and wrong found way;
A deeper force Man felt himself obey.
The fire of conscience burned with flickering flame.
Which hearth-fires lighted, crescent Man to tame.
And so the body's cast of humble clay
Was animated by a flame of fire
Whose penetrating beam foretold the day
When Man to righteous conduct should aspire.
And Nature reach in him her best desire.

R. D. CARMICHAEL.

URBANA, ILL.

THE FADING FAITH.

Two forces, one concrete and visible,
And one articulate, but not attained
Full girth, circle the wreck of justice feigned,
With never seer or prophet to foretell
Their orbits. Not a sentinel's "All's well"
Assures an earthly Paradise regained,
With peace restored and savagery rechained,
To ward from earth another Dante's hell.
Snarling the nations part, each with its bone,
Licking their wounds, defeated all, not shamed
By deeds that sound the very depths of shame.
The masses wake. The seeds of thought wide sown
Now ripen to unfold what all disclaimed.
A greater Samson shakes the temple's frame.

This France, intent on spoil of land and gold,
Is this her voice, in danger well concealed,
Now shrill and loud in clamorous peace revealed!
Or cries again the cruel France of old,
Rapacious, predatory France, whose hold
Laid waste the Rhine land, home and fertile field,
Castle and peasant's patch, whose ominous shield
Was stained with slaughter and crimes manifold!
The star of empire changed its course to save
No furies.—France! Is this the whole of France
Or but a part, the worst! Humanity
Reverted to base aims! An opened grave
Where breed miasmas foul, where false lights dance,
While fades the faith that men may yet be free!

Once more has fortune come to England's aid
At direst need. Storm wrecked the Spaniard's fleet;
The Prussian clinched Napoleon's defeat;
The Boer struck the hour; the German stayed

His hand at rest upon the battle-blade;
Back from the Rhine the Dutch helped England beat
Ambitious France; the victory complete
France turned to English ports the Dutchman's trade.
How fares an earth late shaped to England's ends!
Ally and foe, her rivals twain, both fall,
The German and the Russ. The gathered greed
Of all time past the outcome crowns, and sends
A mime to gloat at a great funeral,
While half the world wears black and still shall bleed.

The constellations dimmed, one fixed star gleamed.
A true Polaris of the four year night.
Westward a menace lurked; Eastward a might,
So vast that it invulnerable seemed,
Loomed over Holland. There had Grotius dreamed
Of open seas and law upholding right.
A greater power than sea force shall indict
Not one, but each land where outlawry teemed.
Loudon! Wise helmsman of a little state
While mighty states are ruled by lesser men.
May Nederland forgive! Can she forget
That when her hands heaped high the outstretched plate
To Belgian refugees, her bread, if hoarded then,
Had saved her own when we drew tight the net?

For every exile shelter, food and care:
For every home a Belgian refugee,
Flaunting aloft no flag of sanctity,
Filled at low graneries too soon made bare,
The Dutch ship sped to Belgium in despair,
Granting what England had refused, the plea
America had sent across the sea.
For facing want the Dutchman still could share.
Time has no record of a charity
So vast, so meanly met. Those refugees—
A million—clothed and housed, made warm and fed—
If never rivals, had been foes. No alchemy
Of state could change in one the manganese
Into the other's gold, or keep them wed.

Like boisterous winds that whirl about the door,
But leave the ashes on the hearth unstirred,
The voices our America has heard,
Press, pulpit, and time serving orator
Have pared the truth, but not revealed the core,
On course and end pronounced no marriage word,
But shunned the backward look, by fear deferred,
Lest to reflect would be but to deplore.
Time will at last assort the false and true,
Assay the hosts fed on forbidden fruit,
The salvage sift for aught of any worth,
And measure out to all what is their due.
Sires may be silent: sons will not be mute
In scorn when they look back on wisdom's dearth.

ISAAC RUSLING PENNYPACKER.

ARDMORE, PENN.

IMMORTALITY AND MONADISTIC IDEALISM.

To reply to the interesting criticisms of my views which Mr. Tsanoff published in the April number of *The Monist* would, I fear, take too long. I will content myself with mentioning two points in which, as it seems to me, he has mistaken what my views are.

He says, "it is presumably taken for granted by Dr. McTaggart that a self's character does not admit of its being involved in such intimate communion with more than one person." I do not take this for granted, because I do not accept it at all. It is possible—for it is often cited—that A should love both B and C, even *sub specie temporis* and at the same time. A fortiori, it seems to me, would this be possible *sub specie æternitatis*.

Again, he quotes my remark: "it does not follow, because a self which has a body cannot get its data except in connection with that body, that it would be possible for a self without a body to get data in some other way." Then he adds the following (the italics are mine): "*That is to say*, it does not follow, because a conscious self

equires sufficient data for its mental activity, that a non-conscious elf need be similarly limited." I am at a loss to conceive how Mr. 'sanoff can have interpreted my sentence in this way. I did not peak of an unconscious self at all, nor of any self which had not ufficient data for its mental activity. What I maintained was that, hile a conscious self with a body could not get sufficient data ithout the help of that body, it was possible that a conscious self ithout a body could get sufficient data in some way which did not equire the help of a body.

J. ELLIS MCTAGGART.

CAMBRIDGE, ENGLAND.

BOOK REVIEWS AND NOTES.

PSYCHOLOGY AND FOLK-LORE. By *R. R. Marett, M.A., D.Sc.* London, Methuen and Co. Pp. x, 275. Price, 7s. 6d. net.

In this book the author (who is the University Reader in Social Anthropology at Oxford) has brought together a number of addresses, essays and reviews dealing with his special subject. Dr. Marrett, following what he regards as the fundamental method of his science, attempts sympathetically to insinuate himself into the attitude of mind of the unlettered peasant as a means of understanding the mental processes of more primitive people. Thus he is interested in ancient customs and beliefs not as museum specimens but as vital expressions of tendencies which civilization has submerged rather than completely destroyed. "Hence," he says, "given conditions unfavorable to the predominance of the scientific temper, the lurking superstition will out; so that the magic-haunted fantasy of aboriginal Australia comes to life again in the witch-mania of a Europe which, paradoxically enough, is in the throes of an intellectual and spiritual re-birth." So fertility charms are still on sale in the East End of London, while in the West End a *séance* with a Witch of Endor is doubtless to be obtained for a suitable fee. This point of view which is arrived at through a thorough intimacy with modern psychology and its methods enables Mr. Marrett to see something like unity in the sphere where his predecessors were wont to find confusion. This suggestive book will raise many expectations which Dr. Marrett will find it no doubt an interesting task to satisfy.

FRANK WATTS.

A SHORT HISTORY OF EDUCATION. By *John William Adamson.* Cambridge University Press; New York: G. P. Putnam's Sons. 1919. Pp. xi, 371. Price, 12s. 6d. net.

This book contains a most convenient and readable summary of the history of Education in England; for it does not (as its title would suggest) deal, except incidentally, with that of other countries. Professor Adamson writes mostly of

institutions—schools and colleges—and the work done in them, since he holds that "the history of education is not coincident, point for point, with the history of opinions concerning what education ought to be." For the earlier centuries the history is admittedly (and at present almost necessarily) based on the researches of the late A. F. Leach; though Professor Adamson does not follow all the deductions which that writer was wont so truculently to preach. There is, however, a useful chapter on the education of chivalry, which trained the many who were not of the scholarly type. But on the whole the account of medieval education is the least satisfactory section; the truth indeed being that far more research is necessary before that history can be adequately written. The account of Humanism, of the New Philosophy and its educational developments (in which, as might be expected from Professor Adamson, Ratke is not even mentioned), and of the eighteenth century, are all excellent. The drab story of the nineteenth century is told as lucidly as may be; though it seems a pity that the continuation of that story should end at 1903. The value and interest of the book are increased by contemporary descriptions of education in various centuries, e. g., those of John of Salisbury and John Wallis, and of works of traditional importance, such as the *Doctrinale* of Alexander de Villa Dei. Altogether it is the soundest text-book on its subject that has yet appeared.

F. A. CAVENAGH.

A HISTORY OF THE CONCEPTIONS OF LIMITS AND FLUXIONS IN GREAT BRITAIN FROM NEWTON TO WOODHOUSE. By *Florian Cajori*. London: The Open Court Publishing Co., 1919. Pp. 293 + vii contents + 6 index. Price, 7s. 6d.

Everybody who is interested in the fundamentals of the Calculus should read this ably written little book. Starting with the works of Newton that contain mention of fluxions, we are led, through a chapter on printed books and articles on the subject which were published before 1734, to the controversy between Berkeley on the one side and Jurin and Walton on the other. Then we have the controversy, Robins and Pemberton versus Jurin, which really produced valuable results; these, leading immediately to several texts on fluxions, ultimately caused the production of Maclaurin's Treatise of 1742. We are then given a bibliography of books published between 1745 and 1761, with extracts and short discussions; of these Professor Cajori remarks that only two were of any real interest, namely, those of Simpson and Emerson. These two works lead to a controversy between Robert Heath and others as partizans of Emerson and John Turner and others as partizans of Simpson; this controversy had little to commend it. The final chapters deal with abortive attempts at arithmetization, later books and articles on fluxions, and criticisms by British writers; a summary of the whole by the author, under the chapter-heading "Merits and Defects," closes a most interesting volume.

There is but one matter for adverse comment: this occurs on page 36, where Professor Cajori founds an argument on the occurrence of the words "at the very *instant*," taken from the translation by Thorp of the Latin of

Newton, without noticing that here is nothing of the sort in the Latin, which is given on page 6. It is Thorp's idea that is thus criticised and not Newton's; for Newton's words are, "*sed tunc cum attingit*," which should have been translated by some such logical phrase as, "but at the *then* when it reaches (this position)." Thus, no matter what the manner may be in which Newton *made use* of fluxions, *he* originally *defined* a fluxion by a *Schnitt*, without infinitesimals.

J. M. CHILD.

VOL. XXXI JULY, 1921 NO. 3

THE MONIST

THE PRODUCTION OF PSYCHIC STATES.

WHEN one takes a comprehensive glance over the field of the philosophy of mind, he cannot but be amazed at the number of gaps that need to be filled and the number of fundamental problems that psychologists have not yet attacked. Among these, the problem of how consciousness originated has only been touched upon; the general function of conscious activity as a biological adaptation demands much clarification. Psychologists have delayed the study of such problems when they have worked exclusively from the presuppositions of behaviorism or psycho-physical parallelism. The behaviorists rightly have put man's actions into the order of nature and denied that a supernatural entity, consciousness, imposes its will on the direction of natural forces. And yet they have missed the full profit of their criticism of the older psychology by failing to see that mental states may have a place in the natural order itself. Parallelism is accepted by many psychologists as a working hypothesis, and as such it has done good service. And yet parallelism, erected into a metaphysical theory, by its very inconceiveability is likely to degenerate into epiphenomenalism, and epiphenomenalism to be replaced by radical behaviorism.

Philosophers also have contributed toward delaying the solution of the psycho-physical problem. The conflict between monists and dualists has deferred consideration of many important aspects of that problem. The strength of metaphysical dualism (animism) is chiefly negative, and the natural desire of man to believe that he has a substantial soul is balanced by a desire to conceive the universe as one,

if possible. We may grant that the issue between monism and dualism is the most important one in the field of cosmology, but in attempting to contribute toward a solution of the problem, it would seem that indirect procedure is more hopeful than direct attack. Now dualism in its present stage of progress is most useful in its *criticism* of monistic theories. At the time *Body and Mind*[1] was written, Professor McDougall made a telling record of these criticisms. Some of them have been answered. In answering them, however, the method employed has been not so much to reconsider the fundamental dispute between monism and dualism, as to seek a consistent monistic position. May we not say, therefore, that it is of the greatest importance now to work the monistic hypothesis for all that it is worth in an endeavor to see whether it will meet all of the difficulties advanced by the dualists?

One step taken in this direction is highly significant, for it nullifies one of dualism's most biting criticisms. Dualists have stressed the difficulties involved in the idealistic position that matter is a form of consciousness. Dr. Strong's searching analysis in his recent book, *The Origin of Consciousness*,[2] has shown that consciousness is *adventitious* to psychic states. Thus, if psycho-physical monism be taken as the best of the monistic theories, the demand no longer exists to explain how matter is a form of consciousness; the problem is shifted to the question: how are we to conceive as one substance matter and the psychic states to which consciousness may, under suitable circumstances, be adventitious?

Another problem that has beset monism in the past is the difficulty of explaining the unity of consciousness. To this question Dr. Strong has addressed himself and made an admirable contribution. In a recent paper[3] I have

[1] London, 1911.
[2] London, 1918.
[3] "The Unity of Consciousness," *Jour. of Phil.*, Vol. 18, pp. 347-357.

endeavored to show that the unifying principle need not, as hitherto supposed, be sought either among psychic states or among sensory neural processes, but may be found in the motor neural processes which govern attention.

Naturally the epistemological problem has been much discussed in this connection. And here the solution most congenial to psycho-physical monism is that of epistemological dualism. The plea of epistemological dualism against objectivism runs: Interpret man's behavior, but do not despise conscious activity. Realize that man will not endure the repudiation of his thoughts and emotions and desires. Find a more complete way of describing his behavior, a way that will include his conscious states.

With the adoption of such a standpoint, the problem of how consciousness originated is recognized, taking the place of a fictitious problem of how a *myth* of conscious activity arose or of a dogmatic assumption of epiphenomenal states with a multitude of unaccounted for qualitative differences. Dr. Strong has made a beginning in his attempt to solve certain difficulties in the way of conceiving mind as a product of evolution. Even if Dr. Strong's conclusions should be accepted in their entirety, however, it is plain that the study of the genesis and development of consciousness are just begun. The present paper is an attempt to contribute one step toward the understanding of how consciousness and psychic states function in human behavior. The particular field of investigation chosen is that of the relation of sensation, feeling, and emotion to their neural bases.

I. A FUNCTIONAL VIEW OF NEURAL ACTIVITY.

§1. In a recent paper,[4] I have maintained that cognition and feeling are independent aspects of conscious activity.

[4] "The Coördinate Character of Feeling and Cognition," *Jour. of Phil.*, Vol. 18, pp. 288-295.

The first assumption of the present paper is that the same independence does not extend to the neural bases of cognition and feeling. I call this an assumption, for it is *conceivable* that a *differentia* of neural substance concomitant with a qualitative conscious difference might be discovered for each of the multitude of conscious qualities. Now science conceives the physical world in terms of a dynamic, uniform substance, organized in a great variety of ways. The neural concomitants of conscious states, therefore, are to be sought in characteristic types of order. Here a choice presents itself: is the order static or dynamic or both? The assumption that I have made asserts that we are not to seek for coördinate static organizations of neural substance concomitant with feeling and cognition respectively. On the cognitive side we do indeed find a limited static differentiation in the case of the sense end-organs and cortical areas. This, however, is not sufficient in itself to account for the diverse cognitive qualities. Some dynamic, or, to use a better term here, *functional* differentiation must also be assumed. But when we come to consider the neural basis of feeling, we do not find specific sense end-organs. It is natural, therefore, to conclude that the neural basis is functional, rather than structural. So far as I know, all the current theories of feeling are in accord with this hypothesis with the exception of Professor Titchener's theory that the free, afferent nerve-endings are organs of feeling—a theory which is not widely accepted. The second assumption that I make is that no sense end-organs of feeling will be discovered.

The two assumptions that I have made are a result of the survey of progress attained in the study of feeling and emotion. The diffuse character of their physiological bases is everywhere asserted. James' theory would make certain sensations the bodily causes of emotions, sensations which have no special emotional character. Dewey's theory

emphasizes the conative aspect of emotions, but here again the emotional character is not specifically localized. Marshall, in his nutritive theory, finds no definite feeling end-organs. Other theories might be cited to support our assumptions. It is not assumed by these theories, however, that feeling and cognition are not coördinate so far as consciousness is concerned. One may give full credence to Titchener's view of the latter question and to the recent results of Wohlgemuth, without claiming in addition that the neural bases of feeling and emotion are more than functional.

§2. A functional view of neural, as related to conscious activity, points the way to a new method of approach to the psycho-physical problem. There has been a general movement away from 'faculty psychology.' It is now generally recognized that consciousness is one in its functioning, and that the different processes into which a conscious moment may be resolved are but distinct *aspects* of a unified process. The spirit of faculty psychology, however, still haunts the systematic psychologists, not in their consideration of conscious activity, but in their consideration of neural processes. Rather than to try to distinguish neural bases of feeling and cognition, will it not be more profitable to consider the conditions of the production of these aspects of conscious activity? Especially significant will be a consideration of their production in reference to attention and to marginal elements of consciousness. I purpose, therefore, to discuss the conditions under which neural processes function now as cognitive, now as feeling-concomitants.

II. THE PRODUCTION OF PSYCHIC STATES IN POINT OF ORIGIN.

§4. The first subject of inquiry relates to the function of psychic states as respects their origin. I may begin by noting a difference in the evolutionary theories of cognition

and feeling. Cognition is explained as a useful means of integrating the sensory and motor halves of the reflex arc when the stimulations are various and conflicting and tend in incompatible directions of motor expression. Thus cognition is conceived to be a useful adaptation at the very moment of origin. With feeling the case is entirely different. The biological function of feeling is conceived to be that of encouraging the individual to persist in beneficial activities and to desist from harmful ones. Here the adaptation implies past experience; feeling is useful in planning action based on the past. It is thus conceived not as useful at the moment of origin, but in the course of experience. As to origin, it is regarded as a chance variation which persisted in the first instance because it was not fatal to the existence of the organism. Needless to say, the furtherance-hindrance theory does not ascribe a survival-value to feeling *at the moment of origin.*

The question, therefore, is suggested: shall we seek further for a survival-value in point of origin? (I present this question because I have in view a description of the functions of cognition and feeling of a mature individual with respect to their biological value. The instrumentalists have laid stress on the instrumental character of the reflective judgment, but Professor Moore[5] refuses to commit them to a more general belief in the instrumental character of all the aspects of consciousness. Now the discussion of mature feeling and cognition raises the question of the place of immediate values in an evolutionary theory.) As to whether feeling is useful in point of origin. I can only say that when we regard its conscious character, feeling at the moment of origin seems to be of contributory value only in increasing the range of contact of the organism with its environment, but I hope to show that when we regard the production of feeling, we find that feeling and cognition alike are comprehended in a unified neural function whose highest point is conscious attention.

[5] *Jour. of Phil.*, Vol. 17, pp. 514-519.

§4. At this point, however, I would dispel a possible misconception arising from the treatment of conscious functions as adaptive. The disputes that linger over this field would vanish if a certain distinction were more consistently made. The whole notion of adaptation admits of only one immediate value. This value is the biological end of evolution, survival-value. All structures and functions that persist without being explained in terms of survival-value, although without survival-value, are not harmful to the organism. The biological treatment is from the standpoint of an observer of the evolutionary process. Now it would be utterly false to imagine that this standpoint does away with intrinsic values. The latter, as well as some instrumental values, subsist from the standpoint of the individual organism. This second standpoint arises in connection with an individual consciousness, and should not be confused with that of an observer of the evolutionary process. Elsewhere I have made this distinction in more detail.[6]

We have, therefore, two centers from which valuations may be made, the consciousness of an observer and the consciousness of an individual. From the individual's point of view, the biological end of value is often swept aside for the sake of values that have arisen, presumably, as accidental by-products of the evolution-process. Thus a martyr, intent on the propagation and defence of ideal, intrinsic values will utterly disregard the "lower," naturalistic end of life with its fundamental instinct of self-preservation. He has the right to argue that the ultimate values of the individual are something quite apart from the original biological function which the structures upon which they depend subserve. He is quite within his right in refusing to accept mediaeval acquiescence in the doctrine that the life-preserving instincts should be exercised only in view of

[6] *Cf. Values, Immediate and Contributory*, New York, 1920, pp. 31-36, 104-112.

their biological end. Mature conscious activity, from the individual's point of view, may be expected to exhibit many instrumental features, especially in the *acts* of consciousness, but in respect to *content* we may expect to find much that transcends the instrumental.

When, however, we consider the origin and function of consciousness from the biological standpoint, we shall seek, from the standpoint of naturalism, instrumental values wherever they may be found. It is my purpose to show how feeling and emotion may be conceived to have usefulness in helping to adjust the individual to his environment.

§5. If, as Dr. Strong argues,[7] consciousness is adventitious to the psychic state, a prior question to that of the origin of consciousness will be: what is the origin of psychic states? We are helped here by the fact of experience that many of the steps of reasoning are conducted on a subconscious or unconscious level, so that it is reasonable to suppose that the gap between a conscious memory and the condition of the brain that subserves the memory is not so wide as has been thought. Since many stimulations are received and transmitted to the brain, but are cognized only after the stimuli have been withdrawn, we must believe that the brain is often near a psychic condition even though the stimulations do not at the time issue in *givenness*. On the border-line between psychic states that are given and psychic states that are not given are objects in the fringe or margin of consciousness. I have argued elsewhere[8] that their behavior in respect to attention indicates that pleasure and displeasure are marginal in nature. I would state further that I believe that welcomeness or unwelcomeness are the conscious indications of incompletely developed psychic states that are positvely or negatively instrumental to the welfare of the organism.

[7] *Op. cit.*, pp. 194-209.
[8] *Jour. of Phil.*, Vol. 18, pp. 288-295.

The theory of psycho-physical monism seeks to close the gap between conscious states and psychic states, on the one hand, and between psychic states and their neural concomitants, on the other. It proclaims the continuity of substance throughout the development of the organism. If consciousness is adventitious to psychic states, we are delivered from the extravagance of the theory that all nature is conscious. If the aspects of psychical activity are functions of neural states, brain-processes in respective functional activities *are* sensations and emotions and feelings. The advantages of psycho-physical monism in a description of the interrelation of the various psychic functions are obvious and need not be refined upon here.

III. THE PRODUCTION OF PSYCHIC STATES IN MATURE CONSCIOUS ACTIVITY.

§6. Our problem is that of investigating the production of feelings and cognitions with special reference to their usefulness to the organism. We shall ask: What is the biological significance of the ideational and emotional elements that go to make up a conscious moment? The answer to this question, so far as the ideational element at the focal point of attention is concerned, is clear. The motor factors of attention are the means of integrating diverse stimulations, and the idea (identical under our theory with its neural basis) is thus biologically useful in giving directions to eventual action. As Bergson would say, our perceptions mark out lines of possible activity of the organism in respect to its environment.

The conditions under which the marginal elements of consciousness are produced are understood on the cognitive side. Whether these elements be the result of present stimulations or the recurrence of images in memory, their presence is conditional upon their belonging to simulta-

neous movement systems.[9] Their biological value to the organism is apparent, increasing, as they do, the probability of useful reaction to present stimuli.

The conditions under which feelings and emotions are produced and their relation to the ideational elements of consciousness, however, have not received the attention they deserve. Here the same two possibilities present themselves as occur in the case of the ideational elements; they may be the outcome of present stimulation, or they may, in some way, be traceable to past experience.

§7. It is necessary at this point to speak of the one theory that would connect certain present feeling-states with past feeling-states, the theory, namely, of "affective memory." A careful survey of the literature bearing on the subject convinces me that the existence or non-existence of such a process cannot yet be demonstrated with certainty. I much suspect, however, that "affective memory" rests on false assumptions. The issue may be stated in the form of three questions: Is there in feeling a process corresponding to memory in the field of cognition? Can memory-images of pleasure and displeasure be recalled independently of the ideas to which they were previously attached? Is the feeling-tone of a remembered idea the one attached to it in the original experience, or is it a new one?

The first of these questions rests on the false assumption that cognition and feeling have coördinate and non-identical types of neural bases. We have made the point that although cognition and feeling are coördinate to introspection, this does not demand that they have different types of neural bases. It is not surprising that feeling is coördinate with cognition in consciousness in view of the fact that qualitatitve differentiation is the predominant characteristic of psychic states. But why should we

[9] *Cf. Movement and Mental Imagery*, M. F. Washburn, Boston and New York, 1916, pp. 130-131.

assume that this coördination extends to their neural bases? Only on the analogy suggested by the existence of sense end-organs and specific cortical areas. The force of this analogy, however, is lost when we consider that neural differentiation is very meager when compared with the differentiation of cognitive qualities.

The second question would appear to be as fruitless as the first. Pleasure is pleasure; displeasure is displeasure. The pleasure attached to one experience is not different from the pleasure attached to another experience. We have no clear evidence that there is such an entity as a *specific* affective-image; feeling appears rather to be *generic* in character. As to the third question, it may be repeated that the assumption is made that there are specific differences of pleasure and displeasure.

Our own theory puts the question as to the existence of "affective memory" in a new light. Pleasure and displeasure are marginal in character; direct attention to them causes them only to vanish and to be replaced by cognitive elements. On the assumption that they have a diffuse neural basis, it is suggested that they may present to consciousness the welcomeness or unwelcomeness to the organism of neural states that have not yet reached a degree of activity where they function cognitively, but are associated with the neural states that function as marginal cognitive elements of consciousness. If this be true, neural activity which functions psychically, will include besides the cognitional determinants certain neural states not sufficiently active to produce cognition, but sufficiently active to produce feeling. The feeling thus produced must be distinguished from the feeling-tone of a present sensation, whose neural basis is probably even more diffuse activity, due to "surplus excitation," the release of "stored energy," chemical changes in organic tissues, *etc.*—precisely which of these is not yet known. I will only suggest that this

theory would yield interesting results if applied to an analysis of the aesthetic experience.

§8. While it is maintained that the neural bases of cognition and feeling do not differ in character, in that a specific neural complex may function at one time as cognition, at another, as feeling, at any one conscious moment the neural bases of the cognitive and the feeling-elements will be different. If direct attention to feeling or emotion replaces it with cognitive elements which were not present when the emotion was felt, is it not reasonable to believe that the neural activity giving rise to the emotion is identical with that giving rise to the previous cognitive experience. This corollary of our theory applies to *any* surplus excitation.

§9. We are now in a position to discuss the significance of the *emotional* elements present in particular conscious moments. There seem to be three possibilities here. Professor Dewey emphasizes that emotion occurs as the result of a conflict of desires. Now it is impossible to attend to two impulses at once. Where attention fluctuates rapidly between two opposed tendencies to act, the emotion may well represent one of the ideas crowding in and endeavoring to replace the other in cognition. This may be called the first type of emotion.

Secondly, the affective aspect may be due to the partial arousal of neural processes that form the basis of past memories. To speak entirely inaccurately, yet suggestively, feelings and emotions here are on the way to becoming ideas. We may speak of this type as the substitution of emotions for ideas. Such occurs frequently when prejudices are aroused. It is a matter of common observation that ideas casually suggested will at times provoke violent emotional reactions. Persons who exhibit prejudice usually do so on scant rational grounds. Someone I know is prejudiced against the wearing of spats, but, when

pressed for a defence of his feeling, gave most inadequate reasons, saying that they do not sufficiently protect the feet, *etc.* I believe that the simplest explanation of prejudice is that old associations are partially aroused. Brought from the fringe of consciousness to full attention, they would, as memories, exhibit conflict between themselves and the idea suggested. Remaining as they do in the margin of consciousness, they serve only to tinge the present idea with a strong tone of displeasure or emotion.

§10. It would be absurd, however, to claim that emotions represent only memories of the past. Genetically, emotions antedate the particular ideas which explain their nature. The child cries before he attends to the object of his grief. The adolescent youth experiences sweet delights of whose biological cause he may be entirely ignorant. Some emotions have their meaning in the undercurrent of past experience, but others burst in upon us as a totally new type of experience. The latter emotions must be traced to inherited, rather than acquired, reactions. They are the conscious indications of the operation of instinctive processes. Their neural basis is inherited associations of cortical states. From the neural standpoint, however, this third type of emotional significance will not differ from the other two types.

IV. PRACTICAL CONSEQUENCES.

§11. In conclusion I would remark upon some of the practical consequences of the theory here outlined. I have forborne studiously to seek any compromise with or help from psycho-analytic teachings in the construction of my theory, preferring to base it wholly upon orthodox psychology. I do believe, however, that it affords opportunity for interpretation of some of the results of psycho-analysis. Here I wish to indicate what appear to be the consequences

of my position in respect to education, particularly in the spheres of ethics and religion.

Why is it that conviction is not obtained among average persons through the presentation of intellectual arguments so easily as through an appeal to the emotions? Why is the appeal to prejudice so potent to secure conviction? We must conclude that the appeal to emotion is wider than the appeal to specific reasons, for in emotion many associations are partially aroused which may join with the conscious idea in checking any attempt to thwart or contradict it. John Mill[10] recognized the importance of associations in explaining the action of conscience. May it not be true that where quick, decisive action is called for, especially from minds essentially unintellectual, the operation of conscience renders a service rather than creates a barrier to correct action?

Again, many philosophers and teachers of religion lay emphasis on the cultivation of feeling and emotion in connection with fullness of living and deepest religious experience. There is a strong predilection among the southern races to regard an emotional nature as more near to "reality" than cold, Anglo-Saxon intellection. The contemplation of an Absolute Idea or communion of man with God in the beatific vision is reserved for the perfection of human nature. Mortals of average intelligence build useful lives on the foundation of wholesome prejudices. In view of the limitations of attention, it would seem that the coöperation of emotion and feeling with ideation were devoutely to be desired rather than impatiently to be set aside. Furthermore, in the case of religious experience there may be experiences not possible to man through ideation alone, the elements of the experience being too many to come to attention at once and too rich to be comprehended in a general concept. Here emotion and feeling, with their

[10] *Utilitarianism*, Everyman ed., New York, 1910, p. 26.

broad range of reference, may serve a necessary and priceless purpose. Practically, then, we shall not reasonably seek to rid ourselves of all emotion, and by so doing lose in imagination and intuition, but we shall rather endeavor to separate the wheat from the chaff in emotions, and correct, rather than abandon prejudice.

The substance of this paper may be summarized as follows:

I. A FUNCTIONAL VIEW OF NEURAL ACTIVITY.

§1. Cognitive and feeling-states are coördinate. But assuming (*a*) that neural states are qualitatively much less differentiated than psychic states, and (*b*) that no specific sense end-organs of feeling will be discovered, we may not conclude that this coördination extends to their neural bases.

§2. If §1 contains a point well taken, it will be profitable to investigate the conditions of production of feeling and cognition, rather than to inquire closely into the structure of their neural bases. The neural difference may be functional, not structural.

II. THE PRODUCTION OF PSYCHIC STATES IN POINT OF ORIGIN.

§3. The origin of psychic states is a matter closely related to the biological (survival-) value of the different conscious processes.

§4. The instrumental value of the conscious processes considered from the standpoint of an observer must not be confused with valuation from the standpoint of the individual.

§5. The origin of psychic states is best explained by the theory of psycho-physical monism, according to which the gap between neural and psychic processes is closed.

III. THE PRODUCTION OF PSYCHIC STATES IN MATURE CONSCIOUS ACTIVITY.

§6. Although the biological function of the cognitive elements of consciousness is understood, that of the feeling —and emotional elements needs further investigation.

§7. "Affective memory," analyzed, proves to be based on the analogy denied in §1. The observations cited in its support find their explanation under the theory that the neural activities which function consciously are wider than those which produce cognitive elements. Feeling is produced when neural states of low intensity function consciously. This low degree of excitation may take place in areas previously aroused by stimulation, or it may be a surplus excitation of present sensations or the rudimentary form of organic sensations, *etc.*

§8. The same functional activity is never the basis of cognition and feeling at once.

§9. An emotion may represent the unattended to idea when two opposed ideas fluctuate in attention. *Or*, it may represent ideas associated with the idea in mind, which have not reached the ideational level of activity.

§10. *Or*, an emotion may be the conscious representative of an instinctive tendency felt for the first time.

IV. PRACTICAL CONSEQUENCES.

§11. Practically, the following consequences of the theory may be suggested:

(*a*) A way of reconciliation of the results of psychoanalysis with orthodox psychology is indicated.

(*b*) The utility of the education of conscience in the moral field is defended.

(*c*) Emotions may serve in religion to put the individual into contact with wider experiences than can be attained through intellection alone.

M. PICARD.

COLUMBIA UNIVERSITY.

THE ESSENCE OF RELIGION.[1]

ONE of the questions which cause both the deepest interest and the utmost disharmony amongst men at the present time, is undoubtedly that which deals with the status of religions and with their future. The most diverse and contradictory opinions are upheld with a degree of erudition and dialectical ability that seem to be the prerogative of no single school. And we are far indeed from being within measurable distance of a mutual understanding.

This extreme divergence in appreciation is due not only to the special nature of the subject, in judging which feeling claims to have a share: it is also due apparently, to the fact that, as a general rule, before discussing the permanence or the decline of religions, we fail to enquire of what it is that religion really consists, what is its essence. What is the meaning of the radical contradiction between the affirmations of the one side and the negations of the other, if neither is speaking of the same thing? When dealing with progress or with decline, is it not absolutely necessary, if we would refrain from judging by appearances, which are so frequently deceptive, that we seriously question ourselves as to the precise object whose degree of vitality we are endeavoring to discover?

Now, it must be recognized that the man who purposes to determine the essence of the religious phenomenon,

[1] [Authorized translation by Fred Rothwell.]

impartially and in a way that is valid to all, will find the problem a singularly difficult one.

The method which, at the outset, offers itself to the mind, consists in studying all existing religions and finding out what they have in common. The religions however that have been, and still are, practised by men, are innumerable; they present every imaginable and unimaginable variety. Many consist of scarcely anything but ceremonies; others almost taboo ceremonies. The latter are altogether *exterior,* the former altogether *interior.* Some recognize gods or a god; others are atheistic. In some, men have need of the gods; in others, it is the gods that have need of men. Some particular religion is mainly a code of morals; many religions are opposed to any idea of morals. Some gods are tolerant or accessible as regards other gods, some particular one, concentrating within himself all power and perfection, recognises no other god as his superior. There are religions that incite men to action, war and conquest; others recommend them to practise renunciation, abstention, and detachment from all things. Some promise immortality, others would have man kill out the desire to live and feel.

What have all these widely different forms in common, unless it be an almost empty concept, a word, a label? What interest is there in enquiring as to the destiny of a thing, the nature of which we cannot attempt to determine without the spirit of erudition at once intervening to prove that our field of observation, being too restricted, allows of no general conclusion being reached?

May we not, however, substitute for this purely logical and abstract method, the historical one, if we would be in a position to reach valid conclusions?

History sets up a fundamental difference between things: it distinguishes between those that are living and those that are dead. Democracy, science and art are living

things: human sacrifices and slavery, though they do exist here and there, belong to the past. History registers the changes that have taken place in the sum total of the conditions of human life. Institutions that are incompatible with the conditions of modern life, though they may seem to exist, are, in reality, but survivals of past forms of existence, and, as such, must disappear.

This is a very clear and plausible doctrine, the more so as it unites mankind with what is most familiar to us: the living being. Assuredly we have not yet discovered the way to bring the dead back to life. But the precise thing we have to consider is whether, in the spiritual domain, the words *dead* and *living* can be applied with the same certainty as in the domain of biology. I read in an article by William Knight, on the historical method in philosophy,[2] "Alike in philosophy and art, in social life, in politics and in religion, all the best things that are ever evolved are superannuated in time. They have to die and be reborn, in incessant palingenesis." Though it may not be possible to say that, in the spiritual order of things, birth necessarily calls for death, and death for rebirth, it is still true that progress frequently consists in recalling to existence, by adapting it to new ideas, some particular form of art or conception of life that seemed to have disappeared for ever. While the whole of the past is not destined to become present again, many shadowy forms, at all events, stretching their arms towards the shores of the future, have a chance to cross the stream, if men continue to be eager for novelty and change. The historian's assertion of the disappearance of a certain form of existence is not sufficient to prove its total and final extinction.

Another way of questioning history is to demand that it reveal to us the primary origins of institutions. Was not the oak previously formed in the acorn? Does not man

[2] *Hibbert Journal*, July, 1904, p. 756.

inherit from the child? The maxim that the water of a stream is purer at its source has certaintly proved itself very productive of results. Still, though a singularly powerful principle in practice, is this maxim a safe guide in theory? As a matter of fact, the source eludes our search. The most remote prehistoric times show us works that are infinitely complex and derivative. So also the child, when beginning to speak, actually goes through processes which call into play all the principles of our logic. Again is it certain that human progress advances in a straight line and that the present proceeds from the past by mere development? The stone which the builders rejected, we read in the Gospel, has become the head of the corner. From the effort to meet the physical needs of man, science came into being, not by a process of development, but by accident: science is the disinterested investigation of truth. It is gratuitous to suppose that there is nothing more in present-day religion than in the taboo or the totem of primitive races. It may be that new elements have been added on to them by a process of epigenesis, and that in these elements is now to be found the center of religious activity. Protestantism was intended to be a reaction against change: it has become the very incarnation of change.

Finally, there is a third way of dealing with history, and that consists in determining the law by which the phenomenon under consideration evolves. By appropriate analyses and comparisons, we throw light upon the phases of this phenomenon, and the constant order according to which, here and there, they succeed one another. Henceforward, this very law constitutes the essence of the phenomenon: it permits to a certain extent, of our foreseeing the future in store for it: a definite and methodical march, like that which a man attributes to the course of his life, when he considers it from the point of arrival, a more or

less visionary march, all the same, lacking the sanction of confirmation, since the future is an unknown quantity. What striking contradictions the future, on becoming the present, inflicts on our most carefully established predictions! These mathematical curves in which we take delight are obtained by leaving out or by taking up divergent phenomena. Now, who can say that some one of these scattered forces, more or less restrained for a time, will not leap up victorious some day, like a spring that has been held down all to no purpose? The order in which moral phenomena succeed one another is not fortuitous, but it is contingent.

An ever increasing number of persons endeavor to add on to or substitute for the purely logical and the historic method, a strictly scientific one. The consequence is that we have two sciences: positive psychology and sociology, both of which endeavor to theorize about religious phenomena. In reality, the results at which these two sciences arrive are rather contradictory than complementary to each other; since, in the one instance, religion radiates from the individual consciousness towards social institutions, whereas in the other case, it has its origin in society and makes its way from without into the individual conciousness. These two methods of explanation, however, have this in common: they tend to break up and destroy that which they explain. Some explanations establish and justify: a master's authority is established by proving his capacity. There are, however, explanations that cause their object to vanish away: the explanation of the sense of initiative by suggestion reduces this sense to an illusion. Religion is the belief in a reality which transcends the laws and phenomena of our world. To prove that such a belief, exclusive of every object corresponding thereto, must of necessity result from the spontaneous play of the natural

psychic or social forces, is to destroy the legitimacy of this belief, and make it impossible in an enlightened mind.

If positive psychology and sociology are to keep their promise, then the question of the essence of religion is very easily solved: religion has no other essence than ignorance. And the real problem can only consist in endeavoring to discover those social or psychological conditions which induced man falsely to imagine that he had dealings with supernatural powers.

But it is advisable to recognise that science, here as elsewhere, is not something complete and existing in itself from all time, thus leaving man no other task than to contemplate it, once he has discovered it. For the last three centuries, there has been substituted for this ontological conception of science, the idea of a purely experimental science, which asks questions of nature though without prejudging the reply. Religious psychology and sociology demand of the human soul and society whether they contain within themselves the wherewithal to explain religious phenomena. Not *a priori* but by considering the results obtained by investigators can we know how far these sciences succeed in resolving religion into elements devoid of religious characteristics. Now, it can scarcely be disputed that hitherto only the externals, the ambiguous traits of religious phenomena have been, in a way, subjected to psychological or sociological explanation.

* * * * * * * * * * *

We are compelled to face the problem of the essence of religion. To state this problem in its true terms, is to enquire whether it is possible, as regards religion, to transcend both fact and concept, and to attain to idea. It is not sufficient to know that religion has been this or that, in order to be in a position to conclude that it is to continue or to disappear. It may happen that it continues in a form

different from those it has hitherto presented. It may also be that it seems to continue, because certain indifferent forms of it remain, whereas in reality it is disappearing as regards all that more especially constituted its greatness.

In like fashion, we see that the knowledge of the simple concept of religion is but a trifling thing. What is called concept includes nothing else than the sum total of the necessary and adequate conditions of the existence of a thing. The concept of religion exhibits the characteristics found in every religion, present in the lowest and the highest alike. To content oneself with this concept in deciding whether religion subsists or is to subsist, is to regard existence, pure and simple, as adequate, without enquiring into its quality. What we should need to possess, in order to pronounce a judgment of any importance, is, strictly speaking, the idea of religion, the Platonic idea, as it were, the notion of what religion can and should be, if it is to exist in the truest and highest way possible.

It is of religion as thus understood, rather than of some one of its historical forms, that it is important for us to know if it exists at the present time, if it appears as though it must continue to exist and to act in the world. It is in this idea of religion that the essence we are seeking strictly consists.

Is it possible to determine such an idea? Are we not simply expressing opinions that are subjective, individual and worthless, when we venture to speak, not of what is, but of what may or ought to be? Is it possible to enter upon such a problem without leaving the plane of fact and reason, without plunging and losing oneself in the void, like the dove with which Kant amused himself? We must note that, both in everyday life, and in philosophical reflection, we have constantly to deal not with concept, but with idea. When we speak of the future of art and science, of democracy and socialism, we are not simply thinking of

which they are capable. According to this view it is advisable to attempt a definition of the essence of religion.

* * * * * * * * * * * *

The history of mankind is the richest and strangest, the most curious and varied spectacle imaginable. Customs, religions, institutions and beliefs, modes of life, aspirations, needs and ambitions, in all these respects the difference is incredible between beings to whom we attribute the same species. The turbulent life, too, of these beings has produced a variety of events disconcerting to the investigator: for the more the latter brings light to bear on the details of things, the more he sees complication, strangeness and novelty, where a superficial glance saw nothing but simplicity and uniformity.

Now, strange to say, every individual, every human group, not only keeps to its customs because they are its own, but because it regards them as superior to those of all others. Every human event, too, is not determined by an insatiable need of change alone; it ought, besides, in the minds of those involved in it, to realize a finer and loftier form of existence than all previous forms. No generation seriously imagines itself inferior to its predecessors. When we delight in analyzing the benefits enjoyed by previous generations and which we do not possess, the very eulogies we confer on our forerunners signify, at bottom, that it is the fault of none but ourselves—by appropriating what they have found useful and good—if we not merely equal, but do not also transcend them.

Now, what is the value of such judgments? Are they wholly absurd? Is human history, in reality, only a vain succession of uselessly diverse forms, or has it really a meaning? If we consider, not societies and their history, but the individual, in the consciousness he possesses of his interior life, we have the same problem. Man is constantly

seeking, with all his faculties, something different from, something better than what he has. A given sensation impels him on to follow after some new sensation. One idea presented to his mind suggests others, leading him to question, compare, philosophize. In his eyes, the goal attained by his will is no longer anything more than the starting-point of some new enterprise.

Whether in the history of his species, or in his individual life man is a being that aspires to transcend itself. What is the meaning, the value of this strange aspiration? Mainly by emphasizing certain aspects of modern science, in answering this question, it is possible to say that man is the victim of illusion, that nowhere in history could any phenomenon take place which is not simply an equivalent of preceding phenomena that gave it birth. *Eadem sunt omnia semper.* Wholly and from all eternity, the universe has been preformed, as regards its elements and laws. If man is conscious of something lacking, some possibility of growth, if he imagines that supernatural powers come to his assistance, these impressions are solely owing to his ignorance and vanity. His power is a given quantity, the mechanical resultant of the natural forces of which he is the accidental and temporay synthesis. His destiny is confined within the limits of this power.

This appreciation of things is very conceivable, and, in certain ways, it is a plausible one; but it is not necessary. Indeed, human reflection has always set forth quite a different interpretation, according to which, man has, in a very real sense, the power to conceive of ends superior to his natural forces; towards these ends it is possible for him to rise, because to his activity may be added that of some being greater than himself and more powerful than nature. In collaboration with this superior being, man may, in very truth, transcend both nature and himself. It appears as

DOES "EVOLUTION" EXPLAIN?

THE demand for a causal explanation of nature processes is inexpugnable from the mind. It is idle to tell us that one event or condition is habitually preceded or followed by another because they are thus juxtaposed in our experience—idle to suggest with Hume, Comte and their followers that all we need to know about change may be summed up by a classification of it into a series of regularly recurring successions. When the earth intervenes between sun and moon we want to know something more than that our satellite is darkened, something more than that when flame is applied to gunpowder the contact is regularly accompanied by a sudden evolution of gas, something more than that the presence of certain bacteria in the blood is the invariable concomitant of a particular disease. The habitual juxtapositions, the regularities of occurrence, the sequences of mode, must be observed and noted. But these do not suffice. The search for cause, however minimized or denied, is implicit in all scientific investigation: nature knowledge has been advanced and our power of predicting phenomena increased just to the extent that to knowledge of the uniformities of succession we have added a theory of the properties or powers which produce the succession and preserve the uniformities. Beneath the "how" of every vicissitude there is always a deeper "why." Things do not change spontaneously. We require a reason, a sufficing ground, an impulsion of some sort, capable

of satisfying us that the change must take place. If bodies are set in motion or brought to rest they are pushed or pulled: there is differential stress, with gravitative, electrical, chemical or muscular action at work as a determining force. We may not be able to "explain" the ultimate cause of change, but we must assume one, and our formal descriptions of the sufficing reason, expressed in terms of force, do really constitute explanation in the only sense in which we can use that term.

Now the doctrine of evolution is essentially a doctrine about changes. Opposing the old view of creation "all of a piece," whether out of nothing or out of something, and the equally untenable view of creation by sudden metamorphoses, it teaches that objects were not always as we see them to-day, but that they have assumed their present shapes and configurations by a process of gradual transformation, and that the vicissitude to which they are subject is still going on. Yet it is far more content to sum up the order of the changes than to offer an account of their producing determinations: it deals, in fact, with formal successions rather than with causal successions—tells us the how of vicissitude without feeling called upon to set forth its why. Fruitful as a formula, the doctrine has been successfully applied to the whole range of the phenomena accessible to us. But the very universality of the process—the ease with which the evidences of it can be accumulated, and the vivid effect which its concrete examples have on the mind—lead inevitably to an exaggerated interpretation of its nature and scope. Evolution is the mode in which material forms emerge or "unfold," yet it has been lifted to the rank of a primary power in the constitution of things. For the popular thought of the time we see it adopted as a key to the solution of all universe problems. Say only that something has been "evolved," and the statement is received as equivalent to an explanation. Even scientific men have

sometimes surrendered to the spell of this magic word, and if we would know how completely a merely model account of nature can be erected into a causal elucidation of nature it is only necessary to recall the recent words of an American astronomer: "Evolution is nothing more nor less than the mainspring of the universe. Grand in its very simplicity, it is the one fundamental fact to which all we know is ancillary. From its influence nothing can escape, for it has fashioned everything, from nebula to man." (*Bulletin of the Society of Arts*, 1909.)

Evolution begins in the inorganic with the appearance of matter—born out of some differentiation of the ether which sets free the play of gravitative forces. But science is undecided as to the nature of the process. Half a dozen hypotheses are in the field. The ether is continuous or it is granular; it is a sort of labile foam; its density is greater than that of steel; or perhaps there is no ether. The matter unit is a coagulation of ether; it is a knot in ether; it is ether in motion; it is corpuscular; it is electrical. A similar uncertainty prevails regarding many of the details of evolution. What, at the outset, is the relation of motion to the thing that moves? We still treat motion either as an ultimate, which does not need explanation through being uncaused, or as a produced derivative the cause of which remains obscure. If all ether energy is kinetic energy, and the thing which moves is refined away into electricity or some other form of motion, we are left with motions that move—a whole universe of them—as the source of the solidities we call matter, while matter is reduced to types of motion in motion. If ether energy is non-kinetic we still await an account of how motion arises and of the relation which must subsist, for the needed unitary view of them, between the energy which is not motion and that which is. If force can be exerted only against resistance, it would be interesting to know why physicists continue to

distinguish between motion against resistance, as on the earth's surface, and motion without resistance, as is alleged in the case of stellar and planetary motions. If there is anywhere in the universe a no-resistance to motion, what becomes of the thesis that action and reaction are equal, and how shall we distinguish between the conditions which initiate change and those which determine no-change? Is conservation of energy limited to the realm of motion, or does it include conservatism of mass?

The doctrine of evolution, with a formula that includes retrogression as well as progress, interests us most as a theory of advance, and it is here, if anywhere, that we have a right to be satisfactorily served. The whole realm of matter, inorganic and organic, has been ransacked to show that there is progress from states of disintegration to states of integration, from the homogeneous to the heterogeneous, from simplicity to complexity, from the undifferentiated to the differentiated, from the incoherent to the coherent. Yet the descriptions do not always fit the facts. If sometimes the contrasted processes and conditions exclude each other, at other times they are manifested in the same aggregate and the same area. Differentiation frequently appears as means to a larger kind of assimilation; the molecules of any particular type of matter, the units of any particular living tissue—all species, in fact, whether organic or inorganic—are fundamentally systems of likes. The changes which constitute social evolution may begin with differentiation, but the progress is finally from the heterogeneous to the homogeneous. In our modern human societies this aspect of advance dominates all others: everywhere we see peculiar institutional forms, social customs, ways of living, even fashions of dress, yielding to an assimilative process which, out of community character and national character, is making world character. As invention runs the industries of countries into like moulds, so commerce assimilates

peoples by promoting like needs and supplying like commodities. With the diffusion of dominant ideas in politics, science, art, literature, even religion, the planet is more and more becoming a community of the like-minded. And even language, which perfects itself by discarding the analytic distinctions and cumbrous inflections of its earlier period, thus progressing not from the simple to the complex, but from the complex to the simple, is already preparing to throw off those isolating distinctions which still make the peoples unintelligible to each other. Throughout international life we thus find writ large the process which is constantly going on within the species, the group, the community, the nation—the setting up of those closer relations which lead to assimilation, the likening which is required for coöperation, and the coöperation which in turn gives rise to the larger forms of resemblance and homogeneity.

It seems to be assumed that somehow or other changes are caused, for without determination of some sort matter would be indifferently at rest or in motion. But evolutionary doctrine leaves great gaps in the connections. Its cogs are often out of gear, and its piston has no visible connection with the driving wheel, plain as it is that the machine works. A tremendous breach of continuity is noticeable in its treatment of the change from inorganic to organic. How progress is made from an object which moves only as it is pushed or pulled to a self-moving system which renews itself after waste and reproduces its like remains after centuries of investigation as insoluble a problem for science as that of gravitation itself. Now the organism must arise out of the inorganic as an expansion of characters regnant also there, if in a more elementary form: it cannot have been thrust into the world as a new kind of object totally unrelated in its powers and functions to objects in general. Yet the appeals to chemistry and physics, to vitalism and neo-vitalism, to psychism and panpsychism, enforced by

researches however praiseworthy, have all failed to explain the transition. We cannot be put off with verbal formulæ which merely re-describe the problem they pretend to solve. It is not enough to tell us that organic matter is highly complex, possesses irritability, is capable of reacting to stimuli, assimilating nutriment, and the like. We want to know how these properties and powers emerge from the inorganic. We need to have cleared up for us—in all its connections, with all its pushes and pulls—the something which makes the living unit not merely dependent in the dynamic sense, but interdependent in the organic and structural sense; which sets up the demand by each for all, the insistence by all on each; which works only through the subordination of part to whole and the domination of part by whole; which, in a word, turns a congeries of molecules primordially indifferent to each other into a society of units system-sourced rather than self-sourced, to impel them one and all towards the self-maintaining activities and configurations that we call life. The analogies which thus relate the individual organism to the species of organisms and finally to human society as a whole must be capable of extension far beyond the limited realm of the living to the sources from which both animate and inanimate derive. But biology is too much concerned with the minute to seek the solvent for its problem in the large. The effect to explain vital characters spends itself mainly in exploration of the microscopic detail of cell structure. Study of the behaviour of the egg-cell after fertilization deals with a secondary process arising out of sex; and Mendelism, frequently mistaken for an explanation of heredity, is no more, if no less, than an account of one of its complications. Supremely untouched by any of these modern conquests of biology is the power of living protoplasm to reproduce its like. Solvents of secondary vital phenomena multiply, but life, out of which they proceed,

remains unanalysed and mysterious. In the attempt to elucidate the organism from itself science misses that large grasp of the nature of life which connects its creative function with the realm of the inorganic and finally with the cosmos.

As the evolutionary view fails to relate vital to prevital characters, so also does it fail to define the inorganic characters out of which heredity emerges as by necessity. The "dominants" of Reinke, the "determinants" of Weismann, the "engrams" of Semon, have all been called in to explain heredity, but their elucidations have been only verbal: they apply to cases in which heredity has become complex, or they subsume a physiological memory inseparably implicated with consciousness. Most scientific discussion in this field takes heredity for granted, as most scientific discussion regarding the "origin of species" takes life for granted. In both the interest centres in secondary results and in complications of these. Given germplasm, what is its relation to the soma or body of the organism? How do the fertilized germ-cells divide, the chromosomes arrange themselves and the processes of ontogenetic development begin? Why is asexual reproduction followed by sexual? Is amphimixis an accident, a mere form of nutrition, or a means of providing material for variation? Do body changes pass to the germ-cells, or do these vary on their own account? Are variations minute and gradual, or "kaleidoscopic?" What part does natural selection play in organic evolution: is it neo-Darwinism or neo-Lamarckism to which we must pin our faith? In all these matters science is at work, not in the foundations of vital phenomena, but on their superstructure. What we need supremely to know, as the very foundation of all other knowledge about the organism, is why and how matter, beginning as inorganic, develops vital characters, setting up that new order in the world of things which we call life.

Yet for science the secret of this portentous advance has thus far been withheld.

Vitalism, whether new or old, offers no help through this *impasse,* nor is the way out shown by the new school of science which teaches that inorganic matter may itself be alive, if with a lower order of vitality—that it may even have a dim sort of consciousness which needs only complexity to make it "intelligent." Psychism in matter tends to panpsychism, and psychism read into the universe process as a means of explaining it stultifies the only kind of "intelligence" we know anything about. It is our habit —imposed on us by our own natures as organisms—to view all appearances of contrivance organically. As our own intelligence is conscious, all other forms of intelligence must be conscious: wherever matter shows adaptation to ends, there we call in consciousness to function as the directing power. We do this in defiance of the plainest evidence, for growth is completed and intelligent processes go on within our bodies without the slightest direct let or hindrance from our conscious states, these being concerned, not with the building up of the organism or with its inner march of events, but with the general activities and mental processes which are needed for relating us to the environment. What we need to have unriddled for us is that power which enables the organism to act intelligently, without aid from consciousness, by virtue of its very nature as living matter—that order which connects the limited organic product with its source, the organism with the inorganic, the animate system with the pre-vital cosmos. The world spreads out before us as if shot through and through with mind. How are we to explain the bond of common process which everywhere links the purposive adaptations of nature with the consciously wrought contrivances of man? Why should the universe, like the intellect, segregate and classify, bringing likes together and

separating unlikes? What is it that matches the rounded boulder with the sphered planet; that relates the spiral of the nebula and the shell to the volute of the Ionic capital, and these to the curl of the wave as it breaks on the shore; that passes from regularly spaced ether pulses to regularly spaced air waves, sand waves and ocean rollers, to reappear in the iterated lines and patterns of man's decorative art; that makes one the geometry of the crystal and the geometry of the honeycomb, the intelligence that shapes the dandelion seed to the wind and the intelligence which builds up human industry, navigates the seas and explores the heavens? Of all this evolution tells us nothing.

In another way evolution is inadequate. Seen from the natural side its rationality is unimpeachable. It is the unfolding of power that eternally is into processes and configurations, into motions, structures, shapes. But the moment we try to make its intelligence conform to that of man our difficulties begin. For human intelligence—the only kind of intelligence we know—a plan is formulated complete, and the fashioning follows the plan. There may be discardings and rebuildings as knowledge accumulates and as new natural properties and methods of utilizing them come to be discovered. But the relation between the mind and its end at any instant is immediate, not provisional or advancing. Now while the machine is a system which works only after it is made, the organism is a machine that works while it is in the making. For the human architect or builder a palace comes out in one piece, not as a series of progressive modifications from an original cave dwelling or mud hut. What engineer planning a bridge would begin with a rope, substitute wood, then put in iron, and finally replace the whole with steel, if in knowledge and resources he were adequately equipped for his task from the beginning? The "Learn to labor and to wait" needs modification even as a bit of worldly wisdom: to address it to omni-

potence is neither logical nor reverent. Yet it is precisely this method of thought and afterthought, of completion and revision, of overturn and re-making, to which the evolutionary teleologists refer the whole furnishing of earth and sky. From non-nucleated protoplasm to nucleated, from unicellular to multicellular, from pre-gastrula to ectoderm and entoderm, from invertebrate to vertebrate, from quadruped to biped, with accompanying changes in modes of reproduction and endless blind alleys of structure and type, nature is one long march from the provisional to the incomplete, one long powerlessness to reach its goal by achieving in a stroke what is needed at once and *de toutes pièces*. And as man finds himself fastened to the evolutionary method, not by the choice of his intellect, but by the nature of his body and its relation to the cosmos, so man is compelled with only rare exceptions that prove the rule to work out his own welfare by the same alternations of rejection and advance, the same lingering in stages that satisfy until they are outgrown, the same beckoning of goals that promise finality only to recede or vanish when they are at last won. It was evolution that armed our predecessor with a flint when he needed a knife, that imposed a clepsydra on him when he deserved a clock, that put him off with sails when steam power should have been his, that kept the stylus in his hand when the printing press should have been recording and perpetuating his thoughts. Perhaps the acquirement of all these good things had to be gradual? How gradually do missionaries introduce clothes-wearing, modern implements and other innovations to the savages they teach? If centuries of evolution are needed for animals and peoples to become up-to-date, how are we to explain the sudden transformation in countries like China and Japan? But "the time was not ripe," "the world was not ready." Would the millions who died needlessly from disease have admitted their unreadiness for antiseptics and

antitoxines in the days before sanitary science and preventive medicine? Were industrial operations ripe for the helping hand of the state only with the advent of factory inspection and shorter hours, women ready to benefit from humane legislation only when the order came to unharness them from the coal truck and the embruting labor of the mines? What was it that so long remanded the reform of asylum and prison abuses if not the necessity of waiting on evolution? Was serfdom right even in Roman days merely because it had not yet been denounced? Is war justifiable because its abolition has not yet come within the range of "practical politics"? That which we see in all these human delays is the what is dominating the what ought to be, the deferred right turning present attainment into relative wrong, the deferred justice making actual conditions relatively unjust. And to the retrospect, individual or social, the sense of deprivation can never be wanting. Nobody will ever accept the view that he has lost nothing by having meted out to him to-day that which ought to have been his yesterday.

The evolutionary method in knowledge, as psychically interpreted, is open to similar objections. Nothing can well be advanced against gradual acquirement and constant revision as a process required by the order of nature. But the claim that it has been imposed upon man by an intellect of like kind with his, to whatever extent wiser and more resourceful, arouses a demurrer from which no system of apologetics will ever free us. "Truth in the making" by all means if, in struggle, suffering, tragedy, we must make it for ourselves; but if we are to be led to it through endless doublings and zigzags by a guide who, knowing the straight path, refuses to reveal it to us, the temper of revolt must be ours along every inch of the hard and stony way. Knowledge slowly and adventurously won, satisfaction following curiosity, the strain of quest rewarded with the joy

of conquest, a thousand times welcome! But offer it as a gift consciously bestowed on the instalment plan—grudgingly parcelled out in bits, like gulps of nourishment administered to the starving who should have been earlier fed—and the intellect rebels. What men need at all times is not the error tempered by fact, the wrong view to be condoned because it is workable, the interpretation *faute de mieux*, the theory sure to be outgrown, but "the truth, the whole truth, and nothing but the truth." We do not instruct our youth that the sun goes round the earth, or that our planet is flat, with the remark that, when their minds are ripe for something better, such statements will be supplemented, revised or wholly superseded. What would be thought of a text-book in any branch of knowledge of which each chapter after the first should qualify, refashion or completely reverse the teaching of that which preceded it, or of which the closing chapter should form the introduction to a new series of affirmations and denials? The earth is the centre of the universe, and all bodies are subservient to it; the universe has no centre, and our planetary habitation is a moving mote in the star-spangled cosmos. The energies are distinct, gravitative, chemical, electrical, vital; the energies are varieties of one all-inclusive energy. The atom is the indivisible ultimate; the atom is divisible, and the electrons are the ultimates, or the ether unit is the ultimate. Mass is invariable; mass is variable according to speed. There is matter and there is electricity; there is no matter, and everything is electricity. Gravitation takes time to "travel;" gravitation is instantaneous. Heat is a substance; heat is a mode of motion. Light is an emanation from the eye; it is an emanation from objects; it is corpuscular; it is made up of pulses propagated in ether; it is distinct from electricity; it is an electromagnetic phenomenon. Life is divinely originated; it is due to a vital principle; it arises out of the physico-

chemical properties of matter. Life is created and species are immutable; life is evolved and species are mutable. The germ-cells are produced by the organisms in which they appear; they are left-overs from previous generations. Consciousness is the driving power of life; consciousness is an epiphenomenon or a psycho-physical parallel. Mind is the summated result of separate items of consciousness; mind is the unity which includes and dominates all these items. And so through the whole round of the sciences, from physics to psychology and from astronomy to sociology, we confront the same resting in half knowledge until it is outgrown, the same progress from old error to new error, the same advance from knowledge invalidated to knowledge provisional, the same lure towards finality and the same disappointments. The method of deferred truth is thus no more satisfying than the method of deferred justice. We accept them as the outcome of a nature of things with which consciousness, will, personality, can have had nothing whatever to do. Viewed as the result of plan, they stultify the only conscious intelligence which is known to us and the only mind of which we can rationally conceive. But give us the universe for our support, with a relative freedom to work out justice and achieve truth for ourselves, and the cruel antinomy dissolves before our eyes.

Any survey of this kind is obviously fatal to the psychic interpretation of nature. In the deepest aspect of such a view we find it weighted with the determination to see the universe not as all-productive and multi-potential, but as restricted to the development of mass and motion, of inter-determining forces, of bodies spatially limited and subject to causally produced change, of inorganic objects maintained and of organisms self-maintained, of life requiring knowledge for its safety and furtherance. And within this aspect, concerning us more nearly and on that account all the more misleading, is our tendency to assimilate the

cosmos yet further to ourselves by reading into it the characters of vitality, will, consciousness and mind—by linking it to human interests and conceiving of our relation to it in terms of human values and human aspirations. Now whatever this attitude may do for religion we cannot regard it as advancing science. The ambition of science, however disguised, is to explain, and the psychic interpretation does not explain: alike in return to the primitive ensoulment of nature and in resort to a supposed elementary vitality in the atoms, it merely adjourns a problem which the very hypothesis admits to be incapable of solution. We might as well try to account for the flower by assuming that stalk and roots are made up of units each of which has something of the flower character, or for water by assuming that it must be composed of atoms and molecules each of which has the water "property." We have here in physics, as once before in biology, the hypothesis of preformation where a theory of epigenesis is needed. Neither vitality nor consciousness can be traced to really ultimate units: they imply and require collectivity. And if we expand the doctrine into panpsychism we confront the insuperable difficulty of realizing how psychic characters ancillary to self-maintenance can either arise or function in an inorganic realm which shows neither activities nor structures that can rightly be called organic. Even if consciousness could be envisaged as a kind of universal entity—vaporous, ghost-like, or what-not—ready everywhere to invade matter, get a grip on it, and carry it along, as Bergson suggests, "to organization" —we should still be left with our puzzle all unriddled; the gap between organic and inorganic would continue to yawn, or would be bridged, not by causal relations, but by formal propositions; the appearances of plan in nature, the suggestions of design in plant and animal, the plain evidences of intelligent adaptations unconsciously reached throughout the realm of life, would receive a merely verbal,

not a real explanation. As by no assumption of an *élan de vie* do we approach even a pretence of accounting for life, so by no assumption of psychical "jets," "spurts," "leaps," "impulses," "upspringings," arising anywhen from anywhere, can we supply the links that are needed to relate the organism to the cosmos.

In seeking extra-organic aid from the *psyche*, whether scaled down to the "electrons" or scaled up to the universe, science is taking a road which—to the defeat of the very method on which its triumphs rest—can only end in a wild subjectivism. It has already accumulated knowledge enough for a provisional view of nature; all that it now needs is a rational use of the materials accumulated. And the goal to be reached clearly lies in the direction of realizing that the universe is infinitely more for itself than it can ever be for man. We must first give up our fatal habit of assuming that the cosmos can be lifted into respectability, as it were, only by projecting into it the local and peculiar characters which we find so valuable to ourselves. Subjectivism in the past has exalted us to a proud superiority over the inorganic things which it has been convenient to sum up as the ether, as matter, as mass and as motion. We have disparaged the world of power about us largely because, impressed by the visible and tangible, we early fell into the mistake of using them as a label for the universe in its totality. A cosmos with a vaster and richer content, alike of actuality and possibility now awaits our contemplation; and within its unutterable sweep we are to discern a system which becomes intelligible to us, not through our ability to spiritualize it, but through our power to interpret the phenomena it presents in the light, so far as may be, of its own nature, process and modes. The time has come to trace to power itself—to the accessible ground of the energies, forces, bodies, motions which we call cosmos—those appearances of design which, in the psychical interpretation

of them, have been subject to age-long acceptance as indications of "mind in nature." But to do this we must emancipate intelligence from necessary implication with consciousness, just as we must emancipate power from necessary implication with motion.

What do we mean, what ought we to mean, by "intelligence?" The subjective element of the conception is most emphasized when the biological sciences are not in question. Yet it is possible to think consciousness wholly away from vital activities without disturbing their modal character as end-reaching, while it is impossible to abstract mentally that character and conceive of them as "intelligent." Even when thrust most vividly upon our attention, consciousness appears only as an added instrumentality, not as a constitutive and fundamental principle. To realize how little we are entitled to look for it in the inorganic world we have only to remember that consciousness is not needed for the vital processes that go on within our own bodies and shades off to a vanishing point in plant life—only to recall that the living body has fashioned its organs unconsciously and without anything of the nature of plan aforethought. Why, then, in the lifeless, the inorganic, should we find "intelligent adaptations? The answer can only be that intelligence is not primarily and fundamentally conscious, but fundamentally and primarily dynamic; that the process we have so long tried to interpret psychically is rooted in the very modes of motion to which power gives rise; that we are in fact dealing with a universe which, strange as the paradox may seem, is "intelligent" before it can be conscious, and purposive before it can develop the faculties of mind. Accept this deliverance from the psychism which, after capturing metaphysics, now threatens science, and our most serious difficulties regarding organic evolution disappear. The self-maintenance we call life links up with the more elementary form of self-maintenance which we know as the

conservation of mass and the conservation of energy. Intelligent action by the organism in relation to environment, shown especially in the invention, fabrication and utilization of tools and machines, connects just as naturally with the unconscious artifice by which the living body develops organs within itself; so both relate themselves to their source in that vaster cosmic intelligence whose ordered configurations in the pre-vital realm appealed to the older teleologists as "evidences of design." For like reasons the account of organic progress as due to a "survival of the fittest" subordinates itself to an account of the origin of the fittest; chance in both organic and inorganic gives way to direction, the purposive is seen everywhere dominating the mechanical, and the real evolution comes into view.

EDMUND NOBLE.

BOSTON, MASS.

THE GENERAL NATURE OF THE CONDITIONS WHICH DETERMINE DEVELOPMENT.

THE saying of the witty *Autocrat* "that the brain often runs away with the heart's best blood" has its application to Philosophy, for every great system of thought springs from profound feeling—from an intense passion for order, a deep longing for unity. In the philosophy of science of the last few decades this was expressed in the conception of sociological phenomena as being organic, or even (at a somewhat earlier period) as in some important aspects physical;[1] and more recently in the comparison drawn between the electronic atom and planetary groups. But the inadequacy of the conception of society as an organism has long been manifest; so that to-day some universal term is required that shall be truly all inclusive. and capable of expressing the concrete character (should there be one) of all reality.

But any such universal character, if it were also truly concrete, would be scientific as much as philosophic—it would be philosophical as expressive of *all* reality, and scientific as applicable to *every* reality. Two modern thinkers agree, however, though for widely different reasons, in rejecting any such identification of science with philosophy;—Bergson, because science is vitiated by the defects inherent in the intellect, and therefore cannot apprehend

[1] *Cf.* Bagehot's *Physics and Politics.* Plato had discovered much in common between the spirit of the individual and of the community.

real duration; and Croce, because science is essentially non-philosophical, and employs not the true concept but always pseudo-concepts.[2] On the other hand Hegel endorses this principle, at least formally; for his first category—Pure Being—although too abstract to permit the thought of "every reality," is still, while purely abstractly, expressive of "all reality"; on the other hand the supreme category—Idea or Spirit[3]—would prove extremely difficult to apply directly in any sense consonant with the present usages of science. But if we follow Dr. McTaggart in his contention that the Hegelian Idea implies that "The Universe is differentiated. It consists of an organic system of individuals," we obtain at once a principle[4] fundamental to all science both in its most general and in its most specialized aspects. The Universe is, in the first place, differentiated; as such it is a system (not for science but) for philosophy; and further, it is differentiated throughout —it is a system of individuals, each of which again is itself a subsystem, great or small as the case may be, and each, from this point of view, constituting the subject matter of some department of science.[5]

If then the term "system" is given its widest and most profound meaning, it becomes equally applicable to all reality and to every reality, and thus the concrete universal of philosophy finds its proper place also in the realm of science. It is certainly unfortunate that the usual meaning of "system" is narrow and specialized; we think of "business" or "memory systems" etc.; still even in these the really essential feature is present in the sense of the completest possible organization—the absence of all super-

[2] *Logic as the Science of the Pure Concept*, p. 46.

[3] *Cf.* McTaggart, *Commentary*, sec. 294.

[4] *Loc. cit.* sec. 292; mathematical procedure is analogous in the transformation or degeneration of equations.

[5] Or other department of knowledge which cannot however, in view of the unity of all knowledge, be severed from science.

fluity and irrelevance. Instead then of regarding society e. g., as an organism, it is philosophically truer to look upon both alike as systems which, while differing in their special details, are similar in their possession of coherence, relevance and interconnection.

The universe again (still following here Dr. McTaggart's reading of Hegel) is an *organic* system; just as no organism is static, so is every natural system essentially dynamic—changing, evolving, enduring. Certainly we may, but only by limitation and abstraction, distinguish states of static equilibrim of shorter or longer duration; but this static aspect is always merely superficial or (in a sense) illusory and, always underlain by force or activity, is but a temporary though necessary stage in the total development; all states of equilibrium arise out of dynamic conditions which at the moment counteract each other. If then we assign to "system" the dynamic character which is distinctive of all living organisms, we are enabled (I think) to trace connections which unite or (to coin a word) "monify" categories of existence apparently widely separated, even if the actual detailed evidence for this is very slight. In this way "vitalism" and "mechanism" become complementary to each other instead of being antagonistic;[6] and I have previously endeavoured to prove that the development of the universe is necessarily a continous advance and never, as a whole, retrogressive.[7]

At first sight, certainly, the concrete phenomena and conditions of this development are so infinitely diverse that knowledge seems compelled to remain always departmental; each science having its own distinct principles, applicable within its special sphere, but yielding at best only analogies, perhaps faint and distant, to other realms of

[6] I may refer to *Science Progress*, No. 50. p. 305.

[7] *The Monist*, April 1920, p. 203. Perhaps "development within the Universe" would be a better expression. How a Universe can truly develop is of course an extremely difficult problem.

truth; thus the laws of motion are as foreign to psychology as are the principles of association to chemistry. Within limits, and mainly in the abstract sciences, this "irrelevance of determining principles," as it may be called, is slowly vanishing; thus mass and energy would appear to be identical, and all forces are probably electro-magnetic.[8]

How far then is it possible to carry this principle of the monistic transcendence of externality? To what extent is it possible to determine *perfectly general* conditions of development?—to express *i.e.* conditions which govern every type of change whether simple or complex, physical, vital, or social. Can we ascertain the universal characteristics of (*a*) all embryonic or early stages, (*b*) all mature and stable stages, whatever be the detailed course development may follow?

There has first to be considered the concept of "origin." Today it is almost a platitude to say that everything has, and indeed must have, an origin; but the obviousness of this assertion should not obscure two important points—(*a*) that the problems of origin are always amongst the most difficult to solve and (*b*) that earlier stages of knowledge, either explicitly or implicitly, assumed that these problems were actually insoluble, and fell back upon statements of which the opening words of Genesis may be taken as the type.[9] Even today it remains true that no assigned origin is ever absolute, and that some degree of relativity, of arbitrariness, or even of conventionality, determines which stage or set of conditions is regarded as original. Subject to these considerations I should like to consider how far the

[8] The irrelevance is at its minimum when knowledge is most abstract *i. e* in pure mathematics, which may be regarded as an extensive and increasing application of a few simple principles, applicable also, directly or analogically, within formal or symbolic logic.

[9] This does not imply, however, that such utterances have wholly lost their value; at the same time this necessarily changes relevantly to the growth of knowledge as a whole.

universal or perfectly general attributes of "origin" can be ascertained.

Every origin, in the first place, however simple it may be, must possess some degree of systematic structure, which again must be, either patently or covertly, of such a nature that some measure of continuity (or in more philosophic language, identity),[10] exists between it and all later stages. Here again we are often driven back upon more or less arbitrary principles in order to establish such continuity. How far *e.g.* is it true to say, in view of the immigrant flood, that the national characteristics of the United States are identical with those of the thirteen colonies? and the same problem appears in a different form if we ask how the ingestion of food and the resultant tissue renewal bear on the identity of the organism.

But wherever there arises this difficulty of determining, from among any series of connected stages, the actual origin, it plainly indicates the absence of any absolutely distinctive criterion; it implies (in other words) that all the stages, whatever their degree of difference may become, are still alike in the possession of some common quality. This universally common quality is (once again) systematic structure; development, that is, in all cases and at every stage consists in the combination[11] of different constituent systems among which, as systems, it is frequently very difficult or indeed impossible to determine the essential origin and continuity; and it is only when one of the many systematic structures becomes in itself obviously dominant that it is selected as the real origin, or basis of true continuity. But this dominance or obviousness is always plainly a matter of degree and of relativity; the immigrants *e.g.* during

[10] Not however the bare identity A=A of formal logic. It is obvious that till this abstract self-identity is somehow transcended no knowledge is at all possible.

[11] In exceptional cases, dissociation, which is merged however in some later combination.

any selected brief period are much more loosely connected than are the United States of that same period; on the other hand, if the German invasion of Belgium had succeeded, the Belgian nationality would have been so radically altered that history would probably have been compelled to recognise a new "origin," as it has often done in times when armed conquests were the rule rather than the exception.

For a philosophy or knowledge ideally complete then every such contributory system would be equally essential, because such a final philosophy would possess the Absolute as its criterion of universal relativity;[12] our actual knowledge, however, must in its incompleteness adopt now one criterion and now another; thus, to cite one example, in the evolution of humanity "origin" and "continuity" assume wholly different aspects according to whether we view personal development as an end in itself, or as contributory to the existence of nationality or humanity as a whole.

But further, in thus insisting on the necessity of the conception of systematic structure, it is obvious that we have passed beyond the consideration of mere change as such. The idea of change merely in itself is superficial and abstract, and of little value beyond very limited ranges of phenomena.[13] Change must be regarded as occurring always within a systematic universe, and as itself therefore sharing in and contributing to its systematic nature; thus viewed it becomes the abstract aspect of some concrete development, and denotes in reality the progressive combination of diverse systems into an increasingly complex whole.

[12] It seems too often forgotten that "relativity" is itself relative; therefore not being itself absolute, it necessarily implies an absolue; as *e. g.* Time in Newtonian mechanics, and "proper time" in relativity mechanics.

[13] But the concept of change has always held a prominent place in philosophy from the πάντα ῥεῖ of Heracleitus to our own day. *Cf. e.g.* "What I find when I look at consciousness is a sequence of different feelings." (Shadworth Hodgson, *Philosophy of Reflection*, vol. I. p 248.) "Such a description", comments James, *Principles of Psychology*, Vol. I, p. 230), "can awaken no possible protest."

I think it is important to notice that this is not a conclusion which, at the present level of knowledge, can be obtained on mere *a priori* grounds; even if there are (as I believe) sound general philosophic reasons in its favour, still a "kaleidoscopic" universe—one *i.e.* in which perfectly haphazard changes constantly occurred which, though governed by law, still served no final end—does not seem *prima facie* to be wholly inconceivable; and in what sense such a world could be regarded as truly systematic is a difficult question.

Actual experience, however, presents to us development from origins; thus far we have seen that in all cases where it is difficult to discover the true origin, this difficulty resolves itself into that of the lack of criteria which enable us to select from among the many cooperating systems any one that is indubitably basal and dominant. But this conclusion has an obverse aspect which I should now like to consider—the problem *i.e.* of those attributes on which our choice of origin is actually based in cases where it proves to be quite well founded.

One such attribute that is very often insisted upon is the simplicity of origins; but this merely in itself is plainly an insufficient, and may even become a wholly misleading, criterion; and this for two reasons—(*a*) because simplicity is itself always relative, and (*b*) because *every* stage in development is in some aspects simpler than succeeding stages. It is true that we can often trace this increasing simplicity back to a point where a single further step would bring us to an earlier system which itself appears highly complex, and we then feel justified in placing the line of distinction between such a "parent" system and the "simple" system which springs from it.[14] But however legitimate

[14] The living germ is the most obvious instance; but this should, for conscious beings, include mental phenomena, which vastly increases the difficulties. But almost all social origins are on the same footing as regards their simplicity.

this procedure may be, it raises two obvious difficulties—(*a*) as to the nature of the "simplicity" of the origin and (*b*) as to its relation to its own previous origin or parent system.

In the first place, it seems exceedingly doubtful whether the "simplicity" thus attributed to origins has any actual existence; here we may often be completely deceived by appearance. Certainly all investigation shows that the living germ is exceedingly complex—as complex indeed in one way as is the adult organism in another; and this again is confirmed by the degree in which the germ itself largely determines the total course of development, which then comes to resemble the breaking down or the unfolding of a pre-existing highly complex but much condensed structure; an interpretation which is still more obvious in the case of the radioactive elements. Here then it is not so much a question of different *degrees* of complexity as of different *modes*, and of the gradual conversion of one mode into the other. Expressed again in still more general terms, all germinal stages appear to have a higher degree of potentiality than the later, so that in this respect the usual contrast as to simplicity is actually reversed. If we compare *e.g.* the spiritual endowments of the "simple" early Roman republic with those of the 'complex" but decadent Empire, there can be no doubt as to which possessed the greatest potential capacity; in all such cases the child is, in a very real sense, the father of the man. And whatever were the defects of the earlier "preformation" or *emboitement* theories of vital development they at least recognized and expressed (if only by implication) the high complexity of all the various stages.

Thus the essential character of origins is not so much the degree, as the mode, of their complexity. Their systematic structure is such that each of the constituents, while

all remaining united together, is capable of entering into a series of combinations continuously, until a new system has been constructed whose elements are so combined *inter se* that few new combinations remain possible. It is obvious that in both cases alike the *degree* of complexity must be very high; the only difference then must be between the two modes; for only a highly complex system will be capable of providing the innumerable bases and connections whereby the resultant system can arise; only an exceedingly complex structure can be thus active and potential, and the simplicity so often ascribed to origins is very largely illusory and abstract.

Development then—*i.e.* the change from original systems to adult—is best interpreted not as an increase in, but as a continuous transformation of, the mode of the complexity of the developing system; and it is obvious that if this transformation were to become complete, development would thereupon cease. In individual cases it does thus come to an end; and the transcendence of this finality is rendered possible only by the conservation, in some way or other, of that special mode of complex structure characteristic of original systems. The most concrete instance is that of the reproductive elements in living organisms; but analogous phenomena occur wherever we find expansion and development—in the spiritual faculties of creative genius—in the adventurous and enterprising members of a nation, be that primitive and obscure or mighty and famous. Thus the maintenance of universal development depends on the union, in all the component individual systems, of two radically different modes of complex structure—the one stable, more or less rigid, narrowly specialized in some limited direction, and therefore incapable of functioning in any other way; and from this arise the elements of regularity and mechanicality;—the other able to enter into a

long series of widely diverse combinations between which it functions as the common basis of union, and so contributes to the universe the contrasted characters of infinite plasticity and originality,—*l'élan vital.*

Reality, then, regarded as a developing whole, everywhere presents these two widely differing aspects; but it is fundamentally important to note that each is indispensable to the other, without whose activity it could not itself exist. This universality of mechanism in the world has always been a serious stumbling block to every philosophy that has considered itself idealistic; its apparent want of that freedom supposed to be inherent in mind or spirit has made it difficult to explain, while its patency makes it equally impossible to explain it away. On the other hand it has been as fully misinterpreted in the opposite direction by those crude materialisms which have taken it to prove that all spiritual values are only epiphenomenal; even Lotze, who, despite his wide scientific knowledge was no materialist, seeks its justification in that direct appeal to "divine wisdom,"[15] which is always a confession of philosophic bankruptcy. Bergson indeed does in a sense attempt to explain it away by regarding the mechanical as but the distortion, due to the intellect, of the true character of reality; and the basal defect of his system consists in this exaggerated insistence on the 'durational" aspect of the world and the consequent unjustified depreciation of all mechanism. It is necessary, of course, to draw between them a profound distinction; and it is probably inevitable that every philosophic system must somewhere place too marked an emphasis; but Bergson's dichotomy is altogether too absolute. For he regards two elements which are in truth complementary and so equally real, the one as merely illusory, while only its fellow

[15] "Conceiving it not as a self supporting fate but merely as a product of divine wisdom;" *Microcosmus,* Vol. I, p. 399.

is truly real; and two correlatively different methods of apprehension again—the one intellective, the other intuitional—then subserve our full consciousness of real being. But such an attitude wholly misinterprets the status of those fixed and completed elements in the world which are the fruits of its eternal process; between these and the processes which brought them into being there need be no antagonism whatever, provided they themselves conserve and maintain, as they obviously do, the means necessary for further development; each then—process and product, the mechanical and the dynamic—is the indispensable basis and complement of the other; nor does any impassable barrier prevent the mind from apprehending the real nature of either; for thought, even when farthest removed from full reality, is a self-condemned exile, and finds, as genius ever does, new life and strength in the deserts of abstraction, whence it returns armed with weapons still more powerful for its conquest of the concrete.

There still remains to be considered the question: In what consists the specific potentiality and complexity of all origins as such? What enables them to initiate and control new courses of development?—new *i.e.* even as individual instances of some generic type, much more when there is no pre-existent class to which they must conform.

The essential characteristic appears to be the advanced level of organisation which all origins possess, relatively (*a*) to their parent systems and (*b*) to the environment in which they can best function. In some respects or other this plane of organisation is always higher than that of both the environment and the parent source; and therefore every element in such an original system[16] is capable of entering into combination with other systems which are

[16] Except those necessary to maintain the system's existence as an origin: *e.g.* the cell wall of organic germs.

(*ex hypothesi*) lower in the level of organisation than itself; for none of these constituents can find its proper complement, or can satisfy its powerful affinities, within the limits of the origin itself. The resultant systems again are (also *ex hypothesi*) incapable of repeating that precise form of combination from which they arose, so that the original capacity for combination becomes automatically more and more limited at every stage in the process; in other words the potentiality of combination necessarily falls as the stability or fixity of the resultant system rises. Potentiality becomes gradually converted into actuality—the dynamic into the static[17]—the "durational" into the mechanical—without however either of these two fundamental aspects acquiring a degree of reality superior to that of the other, as is contended (in one direction) by the philosophies of materialism or of mechanical determinism, and (in the other) by the intuitional philosophy of Bergson.

If we venture to carry the enquiry still a stage further, and to seek the ground of this higher level of organisation to which all origins attain, we can only fall back (I think) on some such general philosophic principle as I have endeavoured to establish in a previous number of *The Monist*;[18] but a few additional remarks may be helpful regarding the difference which exists between the possibilities of organic, and of sociological or historic development.

Regarding the phenomena from the widest possible standpoint, the plasticity of organic development may be called specific rather than individual; the limits of the group *i.e.* appears to be more elastic than those of the individual, whose development is in the main confined to a fixed course from which little deviation is possible. This seems to be true whatever importance mutation theories may prove to

[17] But see the previous remarks on the relation between these.

[18] *Cf.* note 7 *ante.*

possess; for unless a group mutates, the variation is almost inevitably swamped so that reversion to type is assured.

This appears to depend on two causes—(*a*) the fixed character of the organic germ, which again is a necessary result of its material nature; and (*b*) the comparative constancy of the environment of the organic world, which also arises from its material constitution. To what degree the germ plasm is alterable by external influences is still a vexed question, and the inheritance of acquired characters an open problem. The invariability of the environment, again, both as regards its organic and its inorganic factors, is largely relative; nevertheless the operation of these two causes taken together would appear to explain the rigidity (as it may almost be called) of the course of organic development in the individual.

Social and historic progress, however, is on an entirely different plane. Freed from the bonds which confine the world of matter, wholly new influences come into play whose range and capacity are infinitely wider than those which rule the organic;[19] and though History may repeat itself in principle, it can never do so in details. All spiritual development therefore, both national and individual, proceeds within an environment which is itself rapidly developing, and every evolving system becomes an active and powerful factor in modifying the growth of its fellows. It is difficult to say in this respect whether personal or group action is the more effective—whether, in other words, the "great man theory" of History is well or ill founded. The same influence is operative in both cases, but is more concentrated in one than in the other. In every community destined to achieve greatness there must exist (as we have seen already) groups and institutions capable of combining with others, it may be externally through colonisation or

[19] "The Genesis of Freedom," *International Journal of Ethics*, April, 1920.

territorial expansion. On such a community the action of a vigorous personality is comparable to that of an enzyme or catalyst; it controls the social groups which it finds ready to hand and amenable to its influence, having the advantages of more rapid responsiveness to opportunity and less inertia than the group. On the other hand the conservatism of the group acts like a fly wheel and ensures some measure of persistence and continuity.

A few final remarks on the conditions governing the material basis of organic germs may not be out of place. During the protracted fall which preceded the solidification of the earth the formation of chemical compounds would plainly depend on two factors—(*a*) the quantity of the combining elements and (*b*) the strength of their affinity; both of these, again, depend on the electronic structure of the atoms. Their quantity varies with the readiness with which the electrons finally unite to form any stable atom, and the affinity of the attraction between the various electronic systems thus formed. An increased knowledge of atomic structure may reveal laws which express some constant connection between the chemical activity of atoms and their quantitative distribution.[20]

The continuous temperature fall again would necessitate the postponement of those combinations, due to the weaker affinities, which are possible only at low temperatures and in which the attractions are comparatively so feeble that the resultant compounds are extremely sensitive to external influences. This raises the problem as to how the elements concerned in these could be maintained in combination, particularly in any complex compound; probably radiation and enzyme action are among the active factors.

[20] The great range of carbon compounds appears to be connected with the exceptionally high frequency of its atomic vibrations. Gases, again, lead to maximum molecular disorder.

One further important principle seems to be obvious—that in all such complex and sensitive systems the various elements can be present only in extremely small quantities. because only so could they all be brought effectively within the range of mutual action. Thus there is an order of quantity, acting as a limit applicable to all the elements, which cannot be transcended without destroying this sensitive complexity; plainly again, should any one element increase in quantity, each of the others must increase *pro rata* to maintain that particular combination as such. This would be one factor regulating the volume of the organic cell.

These principles may be further extended to complex structures other than purely chemical—to all complex systems which are in consequence highly sensitive to external stimuli; in all these the quantity of each constituent must be relatively small, otherwise (as *e.g.* in the brain) the total quantity requisite for complexity would become too unwieldy. Similarly the non-spatial character of ideal and spiritual attributes enables them to co-exist in their immense variety, so as again to ensure extremely sensitive complexity; and if any man frets because of his personal obscurity and transience, it may console him to realise that these are necessary conditions of all existence within a highly organised universe.

J. E. TURNER.

LIVERPOOL, ENG.

"RELATIVITY."

A SEARCHLIGHT ON HUMAN PERCEPTION.

MODERN science and philosophy reveal with increasing emphasis that we superimpose our human qualities on external nature to such an extent that it has been seriously asked whether matter has any real or "absolute" existence outside of our mind. Many of us have sought comfort in the thought that we possess geometrical axioms and mechanical laws that were as untainted by human-sense perceptions as mathematics. Intellects on other inhabited worlds should find them as immutable as we. Albert Einstein has taken our last stronghold. Fortunately he is not only a destroyer but an upbuilder as well. Into dissent he brings harmony, if mechanics based on one hypothesis is more harmonious than when built upon many. Beyond an hypothetical world explanation we cannot hope to arrive.

We call our new hypothesis "The Theory of Relativity" because we can prove that no two observers can describe a physical happening in the same terms if they are moving relatively to each other; that their measurements of size, weight, velocity, direction of travel, of the object under observation will differ; and further that there exist no means of determining whose measurements are true or "real." Both sets of determinations are of equal value. The greater the relative motion of the two observers, the more will their measurements disagree.

ildering; is there then no reality, no
upon which we can build our concep-
? Let us reassure ourselves; the rela-
e orthodox scientist deals with absolute
is our object presently to make their
his realities bear a similar relation to
various frequencies of light waves bear
ur slowly through the ages developing
t able, and probably never shall be able, to
occurrences in all their aspects or in their
in particular they do not take sufficiently
at *time* enters in a very intimate manner into
s. We must try to grasp that all matter has
me as well as in space; that it is not sufficient
object two squares ahead, three to the right,
p, *i.e.* along three space axes, but we must also
point along our "time-axis" when the observa-
e, if we are to correlate the object in question
ng else in the world. In the "absolute" world
must picture to ourselves, "objects" must be re-
th "events" because when my eye measures the
width and breadth of an object these measure-
onsist of a series of events radiating from the
and experienced by my eye in a string of hap-
s lined up in time and, similarly, any and every-
that happens to, in and around the object takes
and is strong out in time, so that its "real" ex-
ce cannot be described without adding time as a
rth dimension." It is here our imagination balks, but
just when we have formed an understanding of the
ement that time enters into our world picture very
rly in the same manner as length, breadth and height
we also shall understand which measurements have
olute value, why the measurements of the two observers
gree, why gravity acts equally on lead and feathers, and

many other puzzles of science and, lastly, we shall obtain a glimpse of a universe which while without beginning or end, without bottom or top, yet is finite, but without boundaries.

Such a glimpse is worth our while; therefore let us struggle on with our time-dimension or fourth dimension.

As the difficulty we experience, when trying to picture time to ourselves as a fourth dimension, depends on the inadequate development of our senses, we must *intuitively* extend our vision and can most easily do so by first entering into the world of such beings who as yet lack the sense perception of one of our three space dimensions and examine the place time occupies in their universe.

Consider for instance the world of the dog. Our time does not exist to him. He has no concept of yesterday or tomorrow; he lives in a continuous now. *What then constitutes time to the dog?* His behavior indicates that while he has learned to *act as if* there were depth in the picture before him, he cannot conceive distance between two objects lying on one line ahead of him. Therefore when the dog runs along the road the surrounding world becomes a moving picture: the distant trees stand still and the fence posts rush them by. The post opposite his eye belongs to his present, the previous post to his past and the following post to his future. This is precisely the way our time comes in contact with our senses. Our third dimension therefore is *time* to the dog. The past fence post and the coming fence post belong as much to "history" in the dog's life as the past and the coming year are part of our history. The dog sees motion in the landscape before him where we see nothing but stationary objects because we conceive three instead of two dimensions. The dog may run in a straight line and he sees the objects near him in a uniform rectilinear motion; he runs around the corner of the house and the *house revolves*. These motions in the

time of the dog are natural to him; they do not evoke his apprehension. But let something move in our three dimensional sense and it becomes *alive* to the animal whether it be a motor car, a spinning wheel or the cat's own tail. Here is life, mystery and perhaps danger. The blind is an entirely useless adjunct to the duck hunt provided the hunter could keep motionless; strange forms do not frighten the animal, they only arouse its curiosity; but let the hunter move only a finger, sometimes only an eye, and life, that is possible danger, is there. If we now understand what time is to the dog and remember that it "runs across the face of the dog," that is *at right angle* to his space, then we may by analogy understand the real meaning of time in our own three dimensional world. Past, present and future represent motion in the fourth dimension, and this fourth dimension or time axis is at right angle to our space. Furthermore, "the past" to one dog is evidently "the future" to a dog running in the opposite direction, and similarly past and future is a relative conception in our time also and depending on our state of motion. It must be remembered, however, that there is an irrevocable past and an impenetrable future in our time which has no analogy in space. But physical measurements deal with time in a zone, analogous to the landscape in front of the dog, where past and future are purely relative and may even be reversed between two observers.

The table below gives a picture of the evolution of space and time perceptions parallel to the evolution of life.[1]

NO. OF DIMENSIONS	1	2	3	4	5
One dimensional sense-perceptions: Snail	Width	Motion in time	Life Mystery		
Two dimensional sense-perceptions: Dog	Width	Height	Motion in time	Life Mystery	
Three dimensional sense-perceptions: Man	Width	Height	Depth	Motion in time	Life Mystery

[1] P. D. Ouspensky's book *Tertium Organum*.

We must therefore admit that time shares in most of the qualities of space and that all objects, or more correctly, all events (for the substance of matter *is* motion) have extension in four dimensions.

A bridge between orthodox space and time on one hand, and the four-dimensional world on the other, is formed by the fact that light travels 186,000 miles per second and that this velocity can be determined "absolutely," *i.e.* without the uncertainty (apart from errors of observation) that impairs all measurements of smaller velocities, so that we can speak indiscriminately of seconds and miles in our four-dimensional world. To this new world we have given the name: *Space-time*.

Let us now consider why human observations differ from each other when projected into the components of space-time, *i.e.* when made in space and time separately. In our analogy from the world of the dog it is easy to see that his "time" changes direction, as the direction of travel of the dog changes, but for the more exact understanding of the phenomenon we may take an example from our three-dimensional world.

An observer on board a ship in harbor and an observer on shore agree as to the length, width and height of the ship. When, however, the ship steers out on the ocean the ship is gradually tilted with reference to the observer on shore due to the curvature of the earth so that the ship apparently loses in height even if our observer on shore always could see the whole ship. The line that is vertical to him forms a larger and larger angle with the vertical on board so that vertical is partly transformed into horizontal and vice-versa. Although vertical appears very distinct from horizontal to the observer on shore the identical direction has no specific meaning on board the boat at sea. Space is entirely indifferent to the location of our main three axes of reference in space, in other words, it is isotropic. Four

dimensional space-time is quasi-isotropic. It certainly pays no attention to the directions in which different observers count time. To any particular object, at some particular point in space-time, its experiences, which is the stuff it is made of, are strung out in a very distinct time order. But viewed from another object, which moves with reference to the first, the time axis as well as the three space axes are tilted so that time is transformed to space-dimensions and vice versa. There is therefore no absolute differentiation between time direction and space direction any more than between horizontal and vertical in our ship analogy. Space-time is in truth a four-dimensional continuum not a three-dimensional space with time in some manner superimposed. *When time direction as well as space directions are viewed under oblique angles their divisions, say in unit lengths, naturally change size like the height of the tilted ship.* We can already now explain one of the beforementioned puzzles of science. Two famous experiments, performed with great accuracy, seemed to indicate, one that the aether is not carried along with moving bodies but passes or "blows" freely through the interstices of matter. The other proved just the reverse. To account for this baffling result many ingenious theories were offered, the most plausible of which was that all matter in motion suffers a contraction in the direction of its motion and the amount of this contraction was arbitrarily chosen so as to account for the discrepancy. The relativist who believes in four-dimensional space-time calculates the contraction due to the tilting of the axes involved in the experiments and finds that the contraction necessarily must have the value which reconciles the experiments.

It is interesting to note just how large the contraction of the earth must be if viewed from the sun. The theory gives a contraction in the ratio $\sqrt{1-(V^2/C^2)}$ where "C" is the velocity of light and "V" the velocity of the object rela-

tive to the observer. Inserting values for the velocities of light and of the earth relative to the sun, we find a contraction of two and one-half inches on the diameter of the earth. This is a fair example of the magnitude of the corrections that the theory of relativity imposes on the prevalent laws of mechanics and yet what a revolution of thought it introduces.

If we examine the expression $\sqrt{1 - (V^2/C^2)}$ we notice that if "V" equals "C" the whole term becomes zero, in other words an object passing the observer with the velocity of light would appear to have no length, it would have shrunk to a surface. In reality this could not happen because it would take an infinite force to impart light velocity to a particle of matter. This velocity is therefore the highest possible velocity in the universe, that man at present can conceive, and it is furthermore, or rather therefore, "absolute," *i.e.* all observers agree on its value, if measured in vacuum and sufficiently far from gravitational influences.

But are these changes in time and space "real"? A futile question. We cannot say that any point of observation in the universe has preference over any other because we do not know the absolute motion of any point. If we had found an inflexible, unyielding aether-wind blowing through space and matter we might have assumed the aether as standing still and chosen units of time and space measured along reference axes drawn in the aether as our absolute standards. We might then perhaps have permanently separated space and time. As the aether is superflous in the world of relativity, the relativist is indifferent as to whether the aether hypothesis is retained or not.

But we face again the question: how can we describe nature if all our measurements are relative, dimensions and duration depending on the motion of the observer? So far we have only found the velocity of light to be "absolute" under certain conditions. If, however, we follow an object

along its *worldline, i.e.* along its track through space-time, we should be able to make a record of the "distance" we travel, each unit measure along the wordline advancing in both time and space, and make notations of the place and moment at which our track crosses other worldlines, that is note the time and place of all the events that constitute our experience. The time thus noted is called the "proper time" for the worldline followed. The "distance" between two events is called an *interval* and here we meet again an absolutee quantity independent of the point of observation. We share in the motion of all objects on earth to such an extent that the necessity for measuring intervals instead of length and time separately does not occur in our practical life until we commence to explore the stellar spaces or observe particles moving with velocities approaching that of light as for instance particles shot out by radio-active substances. In these macrocosmic and microcosmic worlds, however, we must measure intervals because we are unable to follow the observed objects in their own tracks and are obliged to use "local" space and time directions and we know now that such measurements have no direct application on the object moving relatively to us. The mathematician, however, is able to calculate the interval between two world-points on a worldline from "local" observations much as a surveyor calculates the distance between two mountain tops, that he cannot reach.

Intervals are absolute, *i.e.* the worldline in space-time form a net-work whose location in space-time is independent of the observer. The intervals from knot to knot, *i.e.* from event to event, are not straight. They would be straight for an object moving with uniform velocity in a straight line in three-dimensional space or which is the same, moving with uniform velocity in a space free from other matter. Such motions do not exist in nature. All motions within our experience are curved in three-dimensional space and

very frequently the velocity in the curved path is not uniform but accelerated or retarded. In any case their track in space-time is curved. The worldline of the earth is essentially a spiral, a loop in space pulled out in time to such an extent that the windings are hardly discernible when viewed at right angle to the path. We see a closed orbit only when looking along the time axis so that the windings are superimposed upon each other. In similar manner most worldlines approach straight lines. Why should they curve at all? The curvature in the orbits of the planets in space is, according to Newton, due to a mysterious force, gravitation. Of the nature of gravitation we know literally nothing except that it follows the mathematical law, formulated by Newton, and long considered the model of all natural laws. Newton's well-known law of gravitation states that two material bodies attract each other with a force directly proportional to their masses and inversely proportional to the square of their distance. The mass of a body, or the quantity of weighable matter it contains, has been considered an absolutely unchangeable constant. It has lately been found that this is not strictly true. Particles shot out by radio-active matter have been proved to possess a mass increasing with the square of their velocity. Their change of mass was measurable because their velocity approached that of light, 186,000 miles per second, while the speed of a rifle bullet is less than one mile per second and therefore the change of mass with velocity has entirely escaped our notice until the radio-active substances were discovered. This change of mass with velocity leads to the amazing conclusion, also supported by electro-magnetic theory, that *all mass is due to motion,* whether it be the motion apparent to our senses or the motion with which our intellect has filled the "interior" of matter. But "what" moves there? The "what" must

itself be motion, if it has mass, so that matter, if thought to mean substance, utterly vanishes before our mind.

We see therefore that when we speak of mass in Newton's law we do not accurately know what mass we are talking about. But neither are we able to say what the distance between the two moving stellar bodies is. For what point of observation shall we choose? Thus Newton's law has become ambiguous although the variations involved are of insignificant magnitude as long as we deal with ordinary velocities. It also leads to one of those puzzles of science that relativity delights to explain. The orbit of the planet Mercury is an ellipse the major axis or largest diameter of which should always remain parallel to itself in space according to Newtonian mechanics and except for deviations already known to science. Astronomers have, however, observed a slow turning of this axis amounting to about 42 seconds of arc per century which has no known cause. The accuracy of this observation is so great that the probable error could not be as much as two seconds. Although we have not yet seen in what manner the theory of relativity replaces Newton's law, we might state already now that it gives a value of 43 seconds per century to the turning motion mentioned, one of the most remarkable verifications of a theory in the history of science.

We cannot state our new law of gravitation until we have given a little further study to the quantity mass. We meet it not only in the problem of gravitation but whenever we start or stop, change the velocity or direction of a moving body. When the elevator starts upward we feel an increased pressure from the floor; when the train starts or stops we lurch backward or forward as if there was a magnet pulling us in a direction opposing our change of motion. When the elevator starts upward it is as if our mass or that of the earth had increased. But we know the phenomenon is the result of our acceleration only. And again we

might remove the earth altogether, *i.e.* abolish gravity in the elevator provided we increase our "upward" acceleration with 32 feet per second which is the change in velocity due to gravity. We would then be entirely ignorant of the removal of the earth as far as anything inside the elevator was concerned. In fact, all the phenomena due to an acceleration may be identically reproduced by introduction of a suitable mass *and in small regions the reverse is also true,* as in the case of the elevator. This is the *principle of equivalence* which plays such an important part in the theory of relativity. We see now that by studying acceleration we study gravitation as well. It is a remarkable fact that the entire theory of relativity is with logical necessity developed from the two postulates propounded by Einstein: 1. The constant velocity of light in vacuum. (Along its worldline light does not travel with constant velocity in the neighborhood of matter.) 2. The principle of equivalence.

Let us now look at gravitation and acceleration from the relativist's point of view. We shall first see that mass is relative just as length and time are, *i.e.* dependent on the motion of the observer. This follows directly from the fact that mass varies with velocity and time enters into any statement of velocity. The observer uses his "proper time," *i.e.* measures time along the direction of his "local" time-axis in space-time which is tilted with reference to the local time-axis at the worldline of the moving body and therefore he obtains local time and consequently also local mass. The theory of relativity gives exactly the change of mass with speed found in radioactivity. Again we need not despair less the absolute has disappeared, for mass multiplied with time, which we call action, is absolute, *i.e.* independent of the observer, and gives us therefore an exact basis for our calculations.

In Einstein's law of gravitation "local' 'mass and "local" space-measures replace the "absolute" quantities in New-

ton's law. But, more important yet, the properties of space-time, as revealed by the study of accelerations, explain the curvature of worldlines, without resorting to mysterious attracting forces between distant bodies.

Worldlines curve for the same reason which causes a ball rolling on an uneven surface to change direction according to the inclinations of the surface. Four-dimensional space-time is grooved along the tracks of matter. This is what is meant by the statement that space-time is "non-euclidian." Masses must follow these grooves and the theory also shows that in doing so they fulfill the well-known principle in physics of *least action.*

Popular statements of the "relativity" law of gravitation generally introduce at this point the term "geodesic," *i.e.* the shortest route or interval length between two world-points. These geodesics are not straight lines in non-euclidian space-time and by stating that moving bodies follow geodesics the curvature of their path is supposedly explained. This is not strictly true. Let us take an example from our three-dimensional world, setting time aside for the present. If we are to move from New York to San Francisco the shortest route is through the earth, 2,555 miles long, and we would pass Omaha 204 miles below the earth's surface. If the earth were homogeneous, *i.e.* analogous to "euclidian" space, we would of course follow the straight line everywhere. But as we are apt to strike strata of different hardness, *i.e.* finding our space "non-euclidian," we might make better progress by dodging the hardest spots although thus lengthening our course. In that manner we might find many routes equally entitled to the claim of being the "shortest," *i.e.* to the name of "geodesic" and so we might hesitate which road to choose. But nature never hesitates; there is always some *unique* way of doing a thing and that way is always the choice of nature. With our "superior" intelligence we would prob-

ably suggest that the shortest line from New York to San Francisco is the geodesic of the surface of the earth which joins the two points and is 2,602 miles long; but the German cannon balls would never have reached Paris if they had shot through the air according to the rules of ordinary ballistics; it was only by searching the upper, rarefied layers of air, over a longer route, that the goal could be reached. To those cannon balls "air-space" was non-euclidian and the curvature of their path was governed by the law of "least action." And so in our four-dimensional world moving bodies find their "unique" path not along the shortest possible interval lengths but, peculiarly enough, "least action" is obtained along the *longest possible* interval lengths. (Our analogy is pictorial only and would be entirely misleading if rigorously applied.) Matter is building up space-time as various rocks and strata are building up the volume of the earth and as the various strata of air are building up the atmosphere, so that bodies moving in space-time follow curved paths as the worm in the earth, the road in the hills and the super-cannon ball in the air.

The network of worldlines is therefore distorted in the vicinity of matter. This property of space-time is difficult to conceive but no more so than the mysterious property of gravitational action on distance which the Newtonian theory asks us to believe in. The greater probability of the theory of relativity rests on the fact that it follows with mathematical necessity from the properties of space-time and the principle of equivalence and that its formulas give our present, less precise, laws, in a first approximation, and take care of their shortcomings in a second approximation. Like all theories it must be verified by experience and we have already seen that it accounts for many puzzles and anomalies of orthodox science. We shall now consider the most triumphal verification thereof. We have stated that space-time is grooved along the tracks of matter so that

other worldlines entering such regions must follow the grooves. This must apply to rays of light as well as to ponderable matter. Einstein therefore predicted that a ray of light coming from a distant star would be bent if grazing the disk of the sun on its way to an earthly observer. There is nothing substantial about light but because it exerts pressure on the surface it hits and because radioactivity early had shown that mass may exist by virtue of velocity alone, it was admitted that a ray of light might possibly bend in accordance with Newton's theory of gravitation when passing the sun. The theory of relativity, however, shows that there are two kinds of distortion in space-time around matter, one major, which in the main accounts for the Newtonian law of gravitation, and one minor, confined to space alone, which as a rule is insignificant even for stellar velocities. When we deal with the velocity of light, however, this second distortion rises to the same magnitude as the first and Einstein therefore predicted a deviation from a straight line just twice as large as could be expected if light, indeed, followed the Newtonian law. It is now a matter of common knowledge that the experiment was made during the last solar eclipse on May 29, 1919, and that even conservative scientists had to decide in favor of Einstein.

If therefore we are justified in believing in four-dimensional space-time, *almost* "flat" in *almost* empty regions, and curved where matter is present, we are able to draw a most inspiring picture of our universe. Who has not wondered what is "beyond the stars." If we consider a sufficiently large region of the universe we may say with fair accuracy that matter is on the whole uniformly scattered throughout the region. Each particle of matter contributes a small curvature to space-time so that a ray of light following the path of least resistance, *i.e.* the natural curvature, will be, not smoothly, but continuously bent. Ulti-

mately it must return to its source. The lightpulse will then have explored the entire space-time continuum and found that it is closed. It does not matter in which direction it starts out it always ultimately comes back again. It is therefore possible to explore every point of the universe and we must draw the conclusion that the universe is finite but on the other hand has no boundary. "Beyond the stars" simply does not exist. The difficulty we find in picturing such a universe to ourselves need not deter us from embracing the dogma for—is it easier to understand an infinite world? The best analogy found for closed space-time is the surface of a sphere. Flat beings confined to such a surface and unacquainted with the vertical so that they perceive length and width only must live in the faith of our own ancestors that their world is flat and must, like they, ponder whether it is infinite, whatever that may mean, or has boundaries, and in such case what there is in the great beyond. Imagine their bewilderment if it were proven that their world was finite and yet without boundaries. In whatever direction you started out you would eventually come back. In such a world every point is of equal importance and is a definite part of the whole in fact it is symmetrically placed with reference to the whole. So in our space-time every "event" marks in a sense a "central" point which cannot be disregarded by comparison to the infinite but is indeed an integral part of a definite scheme and interlaced through its worldline with every other part of the entire universe.

J. E. FRIES.

BIRMINGHAM, ALA.

MEMORY AS KNOWLEDGE OF THE PAST.

IN this paper, I propose to discuss memory as it interests the student of the theory of knowledge rather than the psychologist. This does not mean that I intend to disregard psychological considerations but I shall deal with them only in so far as they affect the cognitive problem—and it cannot be denied that they do affect it. This paper divides itself broadly into four parts: (a) preliminary definition of memory; (b) data concerning memory; (c) analytic definition of memory; and (d) corollaries and conclusion.

The word "memory" has at least two meanings: in the first place, it may mean the mere ability to repeat, in the second, it may mean a way of knowing. An example of the first is expressed in such a phrase as, "I remember the poem," meaning "I can recite it," or in "I remember the song," meaning "I can sing it." Memory, in this sense, denotes the presence of a habit, of a disposition which, when stimulated, starts a certain semi-reflex motor process. An illustration of the use of our term in its second sense is found in such phrases as, "I can recall the details of the boat-race," or "I still remember the look on his face," where the word memory is used to denote a certain form of apprehension. As in this paper our problem is cognitive, we shall confine ourselves to memory taken in the second of the above senses.

Parallel to this ambiguity in the word memory is an ambiguity in the word knowledge. We use the term knowl-

one of the sources of knowledge and, indeed, the chief, if not the only, source of our knowledge of the past. In view of the primitive character of memory-knowledge, no good analogy can be established between it and "knowledge" or anticipation of the future; knowledge of the future, such as it may be, is inferred.

(5) Memory is fallible and it would perhaps be more accurate to call memory opinion rather than knowledge. Moreover, memory is a matter of degree; it is clear or vague, faint or vivid, partial or complete.

The above are the most important data concerning memory—the facts that any theory of memory has to explain and to which it has to conform.

We shall now proceed with the psychological analysis of memory. What are the elements which compose it? (1) As has been already pointed out, memory is the apprehension of an image. (2) It is also a form of thought. In sense-perception, psychologists trace what is perhaps a fictitious transition from mere sensation to perception—from a condition in which this or that datum is sensed to one in which the sense-datum, through association or otherwise, takes on meaning; we then have what is called perception of an object. So too, memory represents a stage beyond mere imaging—one in which the image has already become the nucleus of a meaning; in memory we have the thought of an object. Generally speaking, the relation between the datum and the object which it means is of two kinds. Either the datum is similar to its object as in the case of photographs and hieroglyphic language, or it is not, as is true of the word table (written or imaged) standing for the object table, and of all conventional language. Memory is an instance of the first variety. If, in memory, we are thinking of a certain table, then our datum—the image—is a picture of the table. Let us say then that memory is an instance of *pictorial* meaning. (3) But in imagin-

ation, too, we have images with pictorial meaning—images of people and of landscapes. To distinguish memory from imagination, we must introduce another element, namely, the sense of reality, which, in memory, attaches to the image. To mention an analogy from the "movies," imagination is like our state of mind when following a story of the Wild West on the screen while memory is like our attitude when watching the Pathé pictures of current events. In the words of James[2] memory involves "a feeling of belief," which may become explicit in the judgment: 'this is an image of the past."

(4) The following example will show that our analysis of memory is still incomplete. I failed, let us suppose, to attend a football game in which I was much interested. I read a good description of it in the newspaper and, aided by my excellent visual imagery, I form in my mind a clear image which I believe to represent accurately what transpired at the game. My state of mind includes both ideation and belief and yet clearly is not memory. Memory involves something in addition, to wit, the feeling of familiarity or what Titchener calls the recognitive consciousness; this attaches to the memory-image and, on occasions is rendered explicit in the judgment: "I have perceived this before."

These, then, are the four atoms of which memory—the molecule—consists: apprehension of an image, meaning, feeling of belief, and feeling of familiarity. Taking the first and the second pairs respectively, each as a unit, we may define memory as a mental state consisting, on the one hand, of ideation of the pictorial sort, and, on the other, of the molecular judgment: "this is an image of a past event that I have perceived."

[2] *Psychology*, Vol. I, p. 652.

But consider the following example. A is shown a picture of B—an old acquaintance now totally forgotten—and thereupon forms in his mind an image of B, at the same time saying to himself: "So this is B that I knew so well." A's state of mind includes both ideation and the appropriate judgment referring B to A's past; nevertheless, it is certainly not memory. This is because, though A's judgment is similar with a true memory-judgment in content, it lacks the character of logical primitiveness belonging to the latter. A came to know that his image is a picture of B, only because he was told that the photo to which his image corresponds is a photo of B. We should thereupon modify our definition of memory to read as follows: Memory consists on the one hand, of the element of pictorial ideation, and, on the other, of a *primitive* judgment to the effect that the ideate is a past event already perceived by the subject. Note that the judgment need not be explicit; it may be only a feeling, it may even be just a motor set, a readjustment of the nervous mechanism preparatory to action. It is precisely this fact that in the last analysis distinguishes memory from other mental events involving an image, like fancy and the association of ideas—namely, that in memory the apprehension of the image goes with a process of central readjustment which is absent from other analogous mental events. In this respect, memory compares with perception, except that in perception the readjustment is peripheral as well as central.

Finally, of the two elements in memory, the judgment is invariable whereas the element of ideation varies in content with different memory-acts.

So much for the psychological analysis of memory. I will now consider memory in its purely cognitive aspect, as knowledge of the past.

Two views present themselves: one that memory is knowledge of the past by *acquaintance,* the other, that it is knowledge of the past by *description.* The first has several points in its favor. First of all, it fits into appearances. Memory is *some* sort of immediate apprehension—and since the past is its object—why not an immediate apprehension of the past? And then, this view explains matters in a simple fashion. If memory is primitive knowledge of the past, why—it would argue—that is because memory is an immediate contact with the past. And lastly, the theory of memory as acquaintance with the past establishes a definite analogy between memory and perception. The real world is conceived as immediately given in both—in perception, the portion of it which is present, in memory, that which is past. In sum, this theory would maintain that in recalling, *e.g.* one's childhood days at the family hearth, it is the very situation itself, the old room and the grandmother now dead, that appear before one's mind.

The above view is confronted with serious difficulties which far outweigh its merits. (1) In memory one often checks up one's image, judging it to be a good or a bad picture of the object. Therefore, image and object are not the same; in other words, what one apprehends immediately in memory is not the past. (2) One often passes from the content of imagination to that of memory without any hitch. For example, I may suddenly recognize the lovely scenery that I am conjuring in my fancy to be Yosemite Park which I visited last year. It is thus possible for the datum of imagination and the datum of memory to be one and the same thing, and if, as seems clear, the former is not a member of the physical world, neither is the latter. (3) Experience has shown memory to be fallible—not merely in respect of the inferences drawn from it, but in itself; but acquaintance does not admit of error.

It appears then that memory is not knowledge of the

past by acquaintance. Presumably, it is knowledge of it by description. An object is said to be known by description when (a) it is not directly apprehended and (b) is referred to ambiguously or definitely, in terms of some one of its properties or relations, as "a so-and-so" or 'the so-and-so." E. g. I am not acquainted with Milton; but he happens to have written *Paradise Lost* and I refer to him in those terms, as the author of *Paradise Lost*. Turn to memory. That its object—the past—is not directly apprehended has been just shown; that further, it is referred to in terms of some description is indicated by a circumstance noted earlier. We have seen that over and above the image, memory involves a judgment to the following effect: "this is an image of a past event," or "there is a past event similar to this image." To all intents and purposes, this judgment is a reference to the past in terms of the property which the latter possesses of being similar to the image. We conclude that memory is knowledge of the past by description, and, more specifically, knowledge of the past *as the object pictured by the image in the mind.*

To argue that memory is knowledge by description and not by acquaintance is also to maintain that memory is representative and not presentative knowledge. Memory is what some idealists have claimed all knowledge to be. that is to say, knowledge of the external world through an idea which is a copy of the real object. Moreover, memory constitutes a perfect application of the correspondence-theory of truth, for memory is true or false according as the image reproduces the object well or badly.

But to return to our definition of memory as descriptive knowledge. Is memory definite or ambiguous knowledge of the past? That depends upon the circumstances. In recalling the face of my room-mate, I refer to a definite object, my judgment being of the form: "there is one and only one object pictured by 'this' image, and it is the face

of my room-mate." But consider my state of mind in recalling childhood scenes, e. g., the family worship every morning. In this instance, my image is really a composite of my various impressions of the family prayers, and through the image, I am referring ambiguously to *any one* of the instances of family worship in my past.

Let us return to the data set down in the beginning of this paper, attempting to interpret them in the light of the preceding analyses and also glancing at further facts concerning memory.

(1) The memory-act has a definite purpose: to provide knowledge in the form of some assertion of fact. For example, by recalling to mind the scene of yesterday's dinner and after scrutinizing the image, I am led to exclaim: "Yes, it was plum-pudding we had for desert last night." How is this knowledge extracted from the memory-act? To get an answer we need only put to ourselves another question concerning a similar case: How is it that when I hear the telephone ring, I know that somebody wants to talk to me? Obviously, because the telephone-ring is a sign with a definite meaning. So too, the memory-image is a pictorial symbol of a past event, and it is in so far as I give to the symbol some definite interpretation that I am enabled to proceed to an assertion of fact. This process has two stages. In the first, I recognize the object; thus, on apprehending the image, I say to myself, "yesterday's dinner-table!" In the second, I go on to scrutinize the image, meanwhile making appropriate assertions concerning the object recognized, e. g., "the table was decorated with flowers," "it was a round table," etc. And as the image becomes clearer in my mind, I keep making new assertions in ever-increasing number.

(2) *Vagueness.* At least three varieties of vagueness may be distinguished in memory. (a) The first—to which we made an allusion in the paragraph on memory as de-

scriptive knowledge—consists in an ambiguity of reference. An example is the case of the old graduate recalling the class reunions where he often enjoyed himself in the past. In all probability, he has one image in his mind, standing indifferently for any one of these reunions. (b) The second variety consists in an indefiniteness in the recognitive element of memory, e. g., it often happens that we have in our minds an image of a person whom we are sure we have seen before, and yet we cannot recognize him. Habit-memory offers the familiar analogy of tunes persistently haunting our minds without disclosing their identity.

Varieties (a) and (b) may be contrasted as objective vs. subjective ambiguity respectively; in the first case, the vagueness lies in the reference, whereas in the second, the reference is perfectly definite—we are simply unable to locate its term.

(c) The third variety consists in vagueness of the image—vagueness which might prevent me from judging, e. g. concerning the dinner table, whether it was round or square, just as, similarly, vagueness in a photograph might prevent me from judging whether the person pictured had a moustache or not.

Now, we saw that in memory the image serves as a pictorial symbol of the past. We can therefore proceed to characterize vagueness in the first two cases as indefiniteness (objective or subjective) in the *denotation* of the symbol, and vagueness of the third variety as indefiniteness in the *connotation* of the symbol. In cases (a) and (b) we fail to associate the image with any particular object, whereas in case (c) we fail to associate it with any particular meaning.

(3) *Error in memory.* The occasions of error in memory are, I think, twofold. First, the image may be an inaccurate picture of the past or even may not represent anything real at all; secondly, the image may be accurate but

vague. If the first, the memory-judgment: "this is an image of a past event" would naturally be false, as also the assertion of fact based upon the interpretation of the image. If the second, the vagueness of the image might lead to error in the interpretation and thus ultimately to error in the assertion.

(4) We have seen that to remember is to recover a previous impression; what is the relation of the memory--image to the perceptual impression? The image may be (a) simple, corresponding to a single impression, or (b) may be composite, like a composite photo, corresponding to a group of previous impressions. In the first case, it is a plain picture of the object, but in the second it is more like a portrait than a photo of it.

(5) In past discussions of memory, it has been suggested that whenever we remember an event, we are really remembering our having perceived the event. This is not borne out by the facts. I have at this moment an image of Hyde Park, London, which I visited some years ago, without at the same time, having an image of myself seeing Hyde Park. And when the image is composite, clearly, it is well nigh impossible to associate it with any particular impression in the past. Nevertheless, a feeling of familiarity does accompany the image of the event remembered, enabling the subject to "place" the event in his biography—especially if the feeling is fairly definite. In other words, though the event remembered is not necessarily accompanied by the memory of one's having experienced it, it remains true that the event is, so to speak, appropriated by the subject and recognized as part of one's experience.

It is almost impossible to summarize a paper of this nature but several general impressions emerging from the discussion may be recorded. Memory may be described in various ways but, above everything, it is knowledge of the past. Moreover, it is primitive knowledge and there-

fore along with perception and *a priori* knowledge, deserves to be classed among the sources of human knowledge. But memory is fallible and perhaps should on that account be called, in Platonic language, a form of opinion rather than knowledge.

Memory constitutes a double problem, psychological and cognitive; it may be studied as a mental process, or as knowledge of the real world. Approaching it from the first angle, we found memory to be a judgment concerning an image, roughly speaking. More strictly, we found it to consist, on the one hand, of a process of ideation with an image as its nucleus and on the other, of a judgment to the effect that the image is a picture of a past event already perceived by the subject. Approaching memory as a cognitive fact, we found it to be knowledge of the past not by acquaintance but by description, namely, as that which is pictured by the memory-image. We were thus justified in characterizing memory as a type of representative knowledge, the memory-image as a pictorial symbol of fact, and the process of making assertions on the basis of the memory-act as one of interpreting the meaning of the symbol.

RAPHAEL DEMOS.

CAMBRIDGE, MASS.

THE AESTHETIC CATEGORIES.

THE term beauty is sometimes taken very broadly so as to cover the entire field of aesthetic excellence, as by Croce and Carritt.[1] But this use stretches it far beyond its normal meaning; it is better to recognize other coordinate terms for aesthetic excellence. The most notable of these supplementary terms is the sublime. To these the tragic and the comic are often added. Even these will scarcely suffice if we are to find an appropriate category for the genre paintings of Teniers or the novels of Dickens.

If our analysis were to move in the plane of literary usage, the categories would multiply beyond control. Beauty would need to be distinguished from charm, loveliness, delicacy, elegance, splendor, and many such terms; sublimity would invite a comparison with grandeur, impressiveness, and the like. We should encounter a tangle of synonyms leading to endless discriminations in the manner of Prodicus. Let us then abandon the dictionary method, and seek some more definite instrument of classification.

The aesthetic field varies in many ways and is subject to multiple classification. But one of the most important ways in which it varies is in its appeal to specific human instincts. Let us take as our guide the analysis of human instincts worked out by McDougall and refined upon by Thorndike. In this paper I shall assume that the reader is familiar with the views expressed in McDougall's Social

[1] B. Croce, *Aesthetics*, ch. XII; E. F. Carritt, *Theory of Beauty*, ch. IX.

Psychology, which I shall follow, without, however, impugning the validity of Thorndike's more minute analysis; for psychology it may be necessary to split up such an instinct as fear into more specific fears of this and that, but for aesthetics the broader grouping would in any case remain more significant. Our task then is to consider the phases of aesthetic experience as they appeal to the various instincts and propensities of our nature, and to correlate this analysis with the traditional categories.[2]

First of all it should be noticed that there is a formal factor in aesthetic experience which makes little or no appeal to any instinct. This factor is dominant in non-pictorial designs, including Oriental rugs (when their symbolism is unknown or unheeded), jewelry in geometrical patterns, and stained glass (in cases where the representative element is negligible); it is also dominant in those musical compositions in which the emotional effect is minimal or absent, and an abstract pattern of agreeable tones is presented. To be sure a fairly plausible case can be made out for the doctrine that there is no purely abstract design for eye or ear—a line would always be an emotional gesture or a suggestion of the beloved lady's neck, while beauty of sound would be an echo of her voice or else of the shouts of victory. However, the relations of instincts to abstract design and abstract music are subtle and dubious, while our preferences in this field are immediate and vigorous. It seems safer to admit that the function of instinct in these cases is a vanishing quantity. Their beauty lies in their harmony with our senses and with our perceptive processes. Hildebrand and Cornelius have elaborated a theory of the ways in which perception is facilitated by good design; the same can be shown of the musical composer's devices of repetition, variation, contrast, and climax. Our first cate-

[2] *Cf.* the analogous ethical problem worked out by Prof. W. K. Wright in "The Evolution of Values from Instincts," *Philosophical Review*, XXIV, 1915, pp. 166-183.

gory then shall be sensory-perceptual beauty—or, if you like, formal beauty, involving little or no appeal to instinct.

There is no denying that the beauty of human beings is intimately related to sex, but the precise nature and scope of the relation is debatable. Both sexes are most beautiful at the age when they would most naturally woo or be wooed, and in those conditions of health and freedom from strain which are most propitious to wooing. There is a reciprocal relation between beauty and sex attraction. A woman's charm is enchanced by the abstract beauty of her form, coloring, and voice; it would be absurd to maintain that if all women looked like Hille Bobbe in Franz Hals's picture and spoke with strident voices, their attractive power would be no whit lessened. Conversely the beauty of painting, sculpture, and poetry is enhanced by incorporating sexually attractive features; it would be nonsense to assert that Botticelli's Venus or Keats' last sonnet would be as beautiful to sexless beings as they are to us. Our second category then shall be formal beauty enriched by sexual charm.

Another instinct which enriches aesthetic experience is the parental instinct with its concomitant tender emotion. No object is more fascinating to a mother that her child. She is enraptured by its tender and delicately tinted skin, its dainty little hands and feet. The impulse, being a protective and solicitous one, finds a charm in the very helplessness and fragility of its object. This delight in tenderness, delicacy, and fragility spreads into the aesthetic sphere. As McDougall says, 'It is amusing to observe how, in those women in whom the instinct is strong, it is apt to be excited, owing to the subtle working of similarity, by any and every object that is small and delicate of its kind—a very small cup or chair, or book, or what not." (*Social Psychology*, p. 74.) The fact that the taste for smallness and delicacy in artistic objects is more marked in women

than in men confirms its relation to the parental instinct, which is primarily maternal rather than paternal. The beauty of flowers and birds, of fragile Chinese porcelain and Venetian glass, and of fine-spun tracery in Gothic windows, owes much to this protective impulse. Our third category then shall be formal beauty enriched by the parental instinct with its tender emotion.

There is no incompatibility between the two preceding. Rather they tend to go together. In practical life, as McDougall has emphasized, sex attraction normally evokes also the tender and protective impulse. Similarly in plastic art and poetry the ideal of feminine beauty tends to include a delicacy or even a fragility that appeals to the protective impulse. Botticelli's Venus rising from the sea unites the appeals of sex and childlike tenderness, but the baleful flower-clad figure in his "Spring" appeals to sex alone. In Wagner's Tannhaeuser the charms of Elizabeth and Venus differ in the same way. Formal beauty may therefore be enriched by sex and tenderness together, or by either alone.

One further impulse needs to be aroused by all forms of beauty properly so-called—namely that of self-abasement. Without a tinge of humility the sense of beauty is incomplete. When it is absent we call the object merely pretty, not beautiful. A doll-like face may have sensory-perceptual agreeableness of color and form, but in default of individuality, depth of character, novelty or subtlety, it will seem empty or trivial. The faces that appear on the covers of cheap magazines are pretty—perfect in contour and complexion, with liquid eyes rolled in a sentimental appeal to sex and tenderness, but devoid of the depth and subtlety which alone can command the deference of the discriminating. These faces appeal to the *un*discriminating public—which also makes no distinction between "beauty" and "prettiness" in its praises.

There are various means by which the object can command our deference. The suggestion of a rich inner life may do it, as the poise of the Venus of Melos, the reverie of the Hermes of Praxiteles, the subtlety of Mona Lisa, the vital exuberance of Rubens's bacchanalian figures. Preciousness may do it, as in silk, gems, marble, and porphyry, in contrast with cotton, paste, and plaster. So may delicacy of workmanship, as in intricate carving and lace.[3]

This need of humility involves a slight reinterpretation of our category of formal beauty. It is formal in that there need be no depiction or suggestion of the object of any instinct, yet the fact of rarity, the suggestion of skill, or the impression of subtlety may serve to evoke humility.

The impulses of self-assertion and of fear both enter into the sense of sublimity. The former, however, is the primary factor, while the latter gives it a special tone by putting it to the supreme test. When the forces of nature terrify us so that we can think only of our own fear, we have no sense of sublimity, and the situation is a practical evil not an aesthetic good. It is only by imaginatively identifying ourselves with these forces and adopting their power as our own that we feel exalted and call the object sublime. The steep and gloomy mountain side, resisting the climber and threatening him with disaster if he fall, is sublime to us if, instead of being cowed by it, we read into it pride and strength and inhumanity, and exult in appropriating these to ourselves.[4]

Tragedy is the dramatic form of the sublime. Its central feature is the struggle of the hero with hostile forces; to these in most cases he succumbs, but only because it would have required more than human power to resist them. We

[3] Cf. what Santayana says of gems and of skilled workmanship in his *Sense of Beauty*, pp. 212, 213.

[4] Cf. Lipps, *Aesthetik*, Vol. I, p. 527 ff.; Santayana, *Sense of Beauty*, sect. 60).

are exalted by the hero's display of personal force, with which we sympathize and identify ourselves. The experience is rendered "a fearful joy" by the sense of impending or actual disaster, which, however, intensifies the element of self-assertion by straining it to the limit. Since tragedy involves struggle, our pugnacity is also brought into play, and wins a vicarious satisfaction.

The category of the comic is also connected with self-assertion and sometimes with fear. In spite of the violent contrast between the sublime and the ridiculous, the fact that it is but a step from the one to the other is so obvious as to be crystallized into a proverb. In both cases we find self-assertion contrasted with something formidable. In the sublime and the tragic, self-assertion is stimulated by a supreme test; in the comic it is liberated by the collapse of its opponent. Jokes are almost always "on" somebody or something, a weakness or defect of the victim being neatly shown up. It is still difficult to give a better account of our sense of the ridiculous than Hobbes's description of laughter—"sudden glory arising from some sudden conception of some eminency in ourselves, by comparison with the infirmity of others or with our own formerly."[5] Freud has given an illuminating supplement to this by showing how the process of self-discipline and social discipline leaves us full of latent hostilities to convention and to all persons and forces which lay claim to our deference. An easy victory to some aspect of the self is given by the humiliation of the pompous, the betrayal of stupidity, the subjection of solemn thoughts to verbal jugglery.

The relation of the sublime and the comic to formal

[5] Human Nature, ch. IX, sect. 14. Thorndike objects to this that it does not account for the happy laughter of playing children. But this too is usually evoked by some facile triumph—scuffing through autumn leaves, catching the opponent at tag, knocking down the tower of blocks. *cf.* H. M. Kallen, "The Aesthetic Principle in Comedy," *American Journal of Psychology*, XXII, 1911, pp. 137-157.

beauty demands consideration. Shall we say that the sublime is formless and the comic deformed? In many cases this seems to be true. Sublime mountain scenery is formless as compared with a geometrically ordered garden. The stars would be less sublime if reduced to a wallpaper pattern—or even to a religious motto.[6] In literature, however, the sublime usually has a high degree of formal beauty. This is true of the descriptions of God's power over nature in the Book of Job, the favorite passages in Paradise Lost, the song of the archangels in the prologue of Goethe's *Faust*. In painting, Michael Angelo's Creation of Adam has formal beauty as well as sublimity. It seems then that the sublime may dispense with formal beauty; indeed it may derive power from rendering perception difficult[7] (consider the starry sky) just as beauty derives charm from rendering perception easy; but in other cases it may form a splendid union with beauty. Burke recognized this union but did not dwell on it, and the names of "specious" or "fine" which he assigned to it were scarcely well chosen.

In the comic a similar situation emerges. Deformity is one of its sources; but in so far as this means merely departure from type it does not necessarily impair aesthetic unity: the Goops are as coherent as a correctly drawn human figure. Still I cannot think of any comic picture that could be called really beautiful. In literature the comic is compatible with a high degree of beauty, as in the witty speeches of Shakespeare's comedies, and in such verse as Lyly's lyric beginning "Cupid with my Campaspe played." The opera "Don Pasquale" envelops a farcical action in delicate and sprightly music; the product has exquisite beauty.

[6] Cf. Santayana, *Sense of Beauty*, p. 105.

[7] Cf. Bosanquet's distinction of facile and triumphant beauty in the third of his "Three Lectures on Aesthetics."

The beautiful, the sublime, the tragic, the comic—these are the aesthetic categories most frequently discussed. Yet it is astonishing how much of the aesthetic realm falls outside them all. Genre paintings are ordinarily neither beautiful nor sublime, yet they have a value which is assuredly aesthetic rather than theoretical or practical. Romantic novels like Scott's are too diffuse for beauty and are tragic only in spots. Dickens is comic at times but that does not sum up his whole aesthetic value. We need a category that demands less concentrated coherence than beauty, less tension than sublimity; otherwise we shall be at a loss in dealing with a large field of aesthetic experience. The best term which occurs to me is "the interesting," which can well indicate an appeal to miscellaneous interests. Fiction and genre painting offer a vivid and sympathy-awaking depiction of miscellaneous aspects of life; this depiction appeals to similarly miscellaneous interests in us, and is therefore called interesting. To this category nothing is therefore called interesting. To this category nothing human is foreign.

> "Greift nur hinein in's volle Menschenleben;
> . . . . . .
> Und wo ihr's packt, da ist's interessant."[8]

This does not mean, however, that one subject matter is just as good as another, for even Goethe's "lustige Person" would scarcely deny that interests vary in the profundity of their appeal and also in their adaptability to aesthetic treatment.

If there be a primitive tendency to the sympathetic induction of emotion it would appear to be involved in almost the whole field of the interesting. By sympathy here I mean the tendency to share the feelings and attitudes displayed by others. It would account for the fascination ex-

[8] *Faust, Vorspiel auf dem Theater.*

erted by narratives of human adventure and emotion, and would furnish the medium through which all our various instincts may be evoked. In practice sympathy tends to be limited to members of the same group. It has its counterpart in antipathy to intruders and to all beings which are suspected of hostility to the group; as regards them we delight in their distress and are perturbed at their delight, and their mere presence is a source of uneasiness. Antipathy too has an aesthetic function, for it may enhance our excitement and interest—the villain adds much to the play; but a work in which all the important characters are repellent is almost sure to be repellent itself.

Curiosity too plays a large role in the category of interest. Suspense of plot arouses it strongly; the desire "to see how it will come out" is much exploited in fiction and drama. The local color of voyages and historical novels appeals to curiosity, and the varieties of human character do so in an even higher degree.

Sympathy and curiosity then are fairly pervasive factors in the field of "the interesting" and help to give it unity.

On the borderline between interest and beauty lie works which lack the clear pattern of a lyric or a Greek tragedy, and make a strong appeal to varied interests, yet achieve beauty by a pervasive unity of fascinating atmosphere. Such are the Homeric epics, where the music of the verse, the nobility of sentiment, and the facility of the imagery create a charming unified atmosphere. Similarly in our own day Joseph Conrad adds beauty to interest; his style bathes a whole story in an atmosphere which is

"Simple, sensuous, passionate."

It is worth considering whether the opposites of the categories so far considered have any positive character. Beauty, at least, has a positive counterpart in ugliness.

One factor in ugliness is the antithesis of sensory-perceptual beauty: certain combinations of color or of sound seem to be fundamentally at odds with our perceptive apparatus; certain modes of design resist perception, as did the atrocities of the so-called *art nouveau*. Another source of ugliness is disgust, which McDougall regards as one of the primary instincts. Whatever is filthy or morbid tends to arouse this response; it will always be difficult to secure beauty in the depiction of dungheaps or disease. If antipathy is a primitive tendency it should be mentioned here. Whether primitive or not the sentiment of aversion to what is foreign is early and strongly developed. The foreigner is distrusted and disliked—though a specific taboo may make the guest sacred. Hence divergence from the facial and bodily type of one's own group is normally regarded as ugly. The cripple and the idiot are revolting in a different and more profound way because they are alien to humanity—yet not so alien as not to claim human rights. Under the influence of humanitarian ideals we may inhibit this antipathy but I imagine that very few can altogether get rid of it. The positive character of ugliness, which distinguishes it from mere absence of beauty, seems to be due in its various instances to one or more of the factors just mentioned: harshness to sense or perception, a tendency to evoke disgust or a tendency to evoke antipathy.

The sublime, the tragic, and the comic have no positive antitheses; we find merely the non-sublime, the non-tragic, the non-comic. Interest, however, seems to find a positive antithesis in dullness (personified by Pope as a goddess). A series or complex of stimuli, without excellence of form and without power to awake any particular instinct, produces languor, fatigue, or restlessness; thus dullness produces boredom and wins a positive status.

Our attempt to trace the influence of the various instincts on the aesthetic experience leads to the following

results. We have found a significant subdivision of the category of beauty, contrasting formal beauty with that which is colored by sex or tenderness, and noting the role of humility in marking off beauty from mere prettiness. In regard to the sublime and the comic we have emphasized the role of self-assertion, without minimizing the distinction between the tension of sublimity and the *détente* of the comic. In the tragic we have recognized a dramatic form of the sublime, in which our pugnacity also makes itself felt. Furthermore we have felt the need of a supplementary category, "the interesting" which appeals, chiefly through sympathy and curiosity, to an unlimited variety of interests. On the negative side we have found a positive basis for ugliness in harshness to sense or perception, and in the instincts of disgust and antipathy, while a positive basis for dullness appears in fatigue.

If the preceding train of thought led merely to a new classification it would scarcely be worth the trouble. But I think it has a positive value in showing how the aesthetic realm is responsive to our vital interests, so that our aesthetic experience becomes a precious supplement and reinforcement to the other activities of life.

ALBERT R. CHANDLER.

OHIO STATE UNIVERSITY.

THOUGHT AND MENTAL IMAGE, ART AND IMITATION: A PARALLEL.

"CHOOSE a day on which to represent the most sublime and affecting tragedy we have, appoint the most favorite actors, spare no cost upon the scenes and decorations, unite the greatest efforts of poetry, painting and music; and when you have collected your audience, just at the moment when their minds are erect with expectation, let it be reported that a state criminal of high rank is on the point of being executed in the adjoining square; in a moment the emptiness of the theatre would demonstrate the comparative weakness of the imitative arts, and proclaim the triumph of real sympathy."[1] Burke's insistence, in this passage, on the superior claim made upon interest or emotion by the real event contrasts, or seems to contrast, with Durkheim's discovery that among Australian aboriginal tribes the images of totemic beings are more sacred than the beings themselves.[2] A reality can detach interest from a mere representation if Burke's estimate be right; a symbol can excite more emotion than the reality it represents if Durkheim's statement be true. The sides of this antithesis are not in even balance: a real execution does not contrast with a stage-play precisely as a sacred being contrasts with its own symbol nor are spectators in a London theatre Australian aborigines. But Burke himself says

[1] *An Essay on the Sublime and Beautiful*, 1-15.

[2] *The Elementary Forms of the Religious Life*, Swain's Trans., Chap. 1.

that words "affect us often as strongly as the things they represent, and sometimes much more strongly."[3] Our thoughts about things frequently do affect us both more powerfully than the things themselves and very differently from them: memories of our past lives often touch us more deeply than those pasts touched us when they were being lived. It is natural to commend memory proportionately to its vigour and actuality in reinstating the past and imagination when it most perfectly simulates reality. "But at the present day," wrote Longinus," the word (imagination) is predominantly used in cases where, carried away by enthusiasm and passion, you think you see what you describe and you place it before the eyes of your hearers."[4] Such visualisation, such mental re-creation of sights once seen, seems to be an essential, if not the most essential, duty of imagination and memory. Longinus seems to show some favour to this very natural prepossession. "If you introduce things which are past as present and now taking place," he writes, discussing the historical present, "you will make your story no longer a narration but an actuality." His eye is fixed on actualisation as he notes the visualising effects of questions and interrogation in the oratory of Demosthenes:[6] the rhetorical device of asking questions and giving answers converts description into reality. He seems, however, to perceive a power in imagination superior to the mere photographic representation of reality when he contrasts "enthralment" by the "poetical image" with "vivid description" by the rhetorical.[7] Burke saw very clearly that, as a photograph which simply reproduces with fidelity is not art, so imagination is neither mere visualisation of the real nor to be estimated by its success

[3] *An Essay on the Sublime and Beautiful*, 5-7.
[4] *Longinus On the Sublime*, trans., Rhys Roberts, 15-1.
[5] *Longinus On the Sublime, trans.*, Rhys Roberts, 25-1.
[6] *Ibid*, 18-1.
[7] *Ibid*, 15-8.

in achieving actuality. "To represent an angel in a picture, you can only draw a beautiful young man winged; but what painting can furnish out and anything so grand as the addition of one word, 'the angel of the Lord?'"[8] Imagination's separateness of office from mere photographic reproduction or simulation of reality is recognised throughout his famous essay as it is recognised in this sentence. He recognises it most explicitly where it is most evident—in the use of words. "I am convinced," he writes of "compound abstracts" like "virtue" or "persuasion," "that whatever power they may have on the passions, they do not derive it from any representation raised in the mind of the things for which they stand."[9] "The influence of most things on our passions is not so much from the things themselves as from our opinions concerning them," he adds, and, again, "poetry and rhetoric do not succeed in exact description so well as painting does; their business is to affect rather by sympathy than by imitation; to display rather the effects of things on the mind of the speaker or of others, than to present a clear idea of the things themselves."[10] Burke is analysing aesthetic and poetic effects but it never is the principle or most important function of imagination to achieve a complete mental simulation of reality or of memory to construct a perfect mental duplicate of the past. Art is not mere imitation, neither is memory, nor imagination. These principles are interdependent, if they are not essentially one, for art is more than imitation because imagination and memory, on which it is founded, are, in their essence, more than mere methods of mental duplication.

Visualisation, mental seeing rather than thinking, or mental seeing for the purposes of thinking, is probably

[8] *Essay On the Sublime and Beautiful*, 5-7.
[9] *Ibid*, 5-2.
[10] *Ibid*, 5-4.

more prominent in primitive than in civilised men. "There is reason to believe," writes Rivers, "that sensory imagery is more vivid and more necessary to the savage than to civilised persons, many of whom are able to conduct their lives so as to be indistinguishable from the rest though the power of expressing their thoughts by means of sensory imagery is very defective or even wholly absent."

"A difference in such a subjective character as the vividness of imagery among different peoples is not, of course, a theme on which it is possible to produce direct evidence, but the conclusion that imagery is especially vivid and necessary among savage peoples fully accords with their almost exclusive interest in the concrete, with the high degree of development of their powers of observation, and with the accuracy and fullness of memory of the more concrete events of their lives. This conclusion is supported by observation of their demeanour when describing events they have witnessed. I well remember the first time on which I had the opportunity of observing this. On Murray Island, where I gained my first acquaintance with savage people, courts were held by a British official in collaboration with the native chiefs, at which disputes were settled and offences punished. On the first occasion on which I attended these courts an old woman gave a vigorous and animated account of her experience in relation to the case. As she gave her evidence she looked first in one direction and then in another with a keenness and directness which showed beyond doubt that every detail of the occurrences she was describing was being enacted before her eyes. I have never seen a European show by his or her demeanour with an approach to the behaviour of this old women, how closely knowledge and memory depended on sensory imagery."[11]

After civilisation has made inroads into visualising

[11] *Dreams and Primitive Culture*, pp. 11, 12

power James can say confidently that some people have "practically no visual images,"[12] and a "correspondent" that, in spite of many efforts to acquire visual memory, he must make "certain mental notes while observing the object" to "make an accurate memory drawing" because he has "no image worth mentioning" from which to draw his "image of the object."[13] A legion can be decimated without being completely destroyed and visualising power still persists, though scattered among fewer individuals. Professor Titchener says he can read off a memory manuscript.[14] He and his fellow-visualisers seem to benefit by not suffering forfeiture of their legacy from the past. It is an advantage to read manuscripts from memory; it is also an advantage for a blindfolded chess-player to see board and men in his mind. An American who played chess blindfolded told Taine that, after a fixed look at the board before the game began, he followed every move in his mind as if he had seen it played. He saw board and men at the end of each move as if there were no bandage on his eyes. He was so used to visualising each move as it was told to him that he was actually more easily deceived when he looked at the board than when he pictured it in his mind. Visualising power also helps in arithmetical calculation: Colborn, a young arithmetical prodigy, told Taine that he saw his calculations clearly before him and "another" that he saw the figures as though they were written on a slate.[15].

These feats of visualisation seem to be successes for the real functions of imagination: perfect memory pictures are useful and imagination seems to be dramatic and effective in proportion to its power of presenting pictures—to

[12] *Principles of Psychology: Imagination.*

[13] *Times Educ. Supp.*, Jan. 15, 1920. "What Is Imagination?"

[14] *Lectures On the Experimental Psychology of the Thought-Processes*, Chap. 1.

[15] *De L'Intelligence*, Tome 2, Chap. 1.

its profusion and vividness of authentic imagery. Visualisers like Titchener and Colborn seem to have escaped from a process of decay which civilisation has inserted into primitive mental powers. Writers, like Shakespeare, who abound in images, who are fertile and vigourous in metaphor, seem to rise to their mental heights because visualisation has tarried with them after departing from others. But visualisation has its victims no less than its beneficiaries. Taine cites the experience of a gendarme who had charge of a condemned criminal and saw his head severed by the knife of the guillotine. The terror of that fatal moment settled on his soul. He imagined that his superior officer, suspecting him of guilt, was planning his arrest; voices shouted accusations at him from the clock; he saw the guard approach and soldiers surrounding his house. He armed himself, fled to a wood and resisted all attempts at capture—driven into exile by obsessing visions.[16] Images, pictures in the mind, which are part of thought, are reacted to as if they were things when they copy reality too faithfully. Vivid visualisation, comparable in vigour and clearness of picture to the actual seeing of physical objects, seduces the mind to confuse things with its thoughts about them. A rush of memory, which is thinking about the past, may momentarily persuade us that we are in the past again. Dreams constantly reinstate the past in literal truth through the posing of memory as actual event. Memory defeats its own purpose when the mental image too vigorously simulates reality and imagination, if it visualises right to the top of its bent, compels the mind to behave as if it were among real scenes instead of being surrounded by thoughts.

Visualisation, mental picturing, also induces a systematic, reflective, theoretical confounding of thoughts with things. Yeats quotes Shelley's saying that "thoughts

[16] *De L'Intelligence*, Tome 2, Chap. 1.

which are called real or external objects" differ only in regularity of occurrence from "hallucinations, dreams and ideas of madmen." An expositor might conclude from this to an idealistic identification of all things with thoughts, which is one way of interpreting an essential similarity between visual pictures impressed upon the mind by visible objects and visualised images in hallucinations and dreams. Yeats inverts this idealistic identification into a realistic homology of mental images with physical things: instead of making external objects into thoughts or images he makes images into external things like stocks and stones. "If all our mental images no less than apparitions (and I see no reason to distinguish) are forms existing in the general vehicle of Anima Mundi and mirrored in our particular vehicle, many crooked things are made straight."[17] Visualisers are always tempted into this psychological or metaphysical delinquency of conferring the externality appropriate to physical things upon mental images. "Forms existing in the general vehicle of Anima Mundi" have obviously received this conference. Images are mental devices for thinking about things (and also about other entities). A writer can invite thought about horses by using the word "horse": the word received as a picture by his readers does not induce them to confuse thinking about the animal with a belief that it stands before them. He can extend the same invitation by drawing a picture of a horse and his readers can again think about horses without supposing them to be present in person. The mental picture or image of a horse, as distinct from a perception of a real, present animal, serves the same purpose for thinking as the writer's picture: it is not the animal, or, in essence, an attempt to portray it as if it were present, it is a mental instrument for thinking about it. The mental visual image could not be adequately replaced by

[17] *Per Amica Silentia Lunae*, Chap. 7.

the word "horse" if it were in essence an imaginative attempt to portray the animal and not essentially a means of thinking about it. But the visual images involved in visualisation, because they are instruments of thought based on simulation of the visual aspects of things which convey to us our most impressive and most systematised experiences of outer realities, if imagination centres on them too freely, become confused with external things. They hallucinate if imagination approaches too closely to a positive reproduction of a perceived reality; they promote systematic mental confusion when imagination centres too exclusively upon them as objects, rather than as devices for thinking, without actually conferring upon them the perceptive status of external things. Yeats has obviously succombed to this impulsion into mental confusion. "A. E." also succombs, and unreservedly, to the visualiser's impulse when he writes "But the dream figure or figure of imagination will walk about with authentic motions and indistorted anatomies."

"I imagine," he continues, "a group of white-robed Arabs standing on a sandy hillock, and they seem of such a noble dignity that I desire to paint them. . . I say to myself, 'I wish they would raise their arms above their heads,' and at the suggestion all the figures in my vision raise their hands as if in salutation of the dawn. . . My brain does not by any swift action foresee in detail the pictorial consequences involved by the lifting of arms but yet by a single wish, a simple mental suggestion, the intricate changes are made in the figures of imagination as they would be if real Arabs stood before me and raised their hands at my call."[18] He succombs to the visualiser's impulse because he concludes from experiences like this that images can enter the mind from *without*. When "A.E." subsequently writes "I remember incidents rather

[18] *The Candle of Vision:* "Have Imaginations Body?"

than moods, vision more than ecstasy"[19] he probably intimates his mental habit of attending more to his visualised images than to their significance: of accepting them as models of realities rather than as means of thinking about these realities. He habitually treats them as models by painting from imagination in preference to sight. The visualising habit, convenient for specific reference in memory, converts the mental image from its essential rôle as an instrument of thought into an actual duplicate or model of external things. The model becomes confused with its prototypes in the outer world and "A. E." can write, treating the mental image as a ball that can be thrown from hand to hand, "I know that with the pictures of memory mingle pictures which come to us, sometimes from the minds of others."[20] He can speak of the "etherial medium which is the keeper of such images," thus relegating mental images to the outer existence and persistence of pebbles, of his ability "at times to evoke deliberately out of the memory of nature pictures of persons or things long past in time"[21] and even suggest "that images of things to be may come into our sphere out of a being where time does not exist."[22] Visualisation has its conveniences and it has its powers, but the essential function of imagination, in all its forms, is not picturing but the use of images as instruments of thought.

Human thought often seems to follow a route decided for it beforehand by the constitution of things and by the equipment of the mind. It was probably inevitable for Plato to start in one such route and write "Then must we not infer that all the poets, beginning with Homer, are only imitators; . . . The poet is like a painter who, as has

[19] *Ibid:* "Intuition."

[20] *The Candle of Vision:* "The Mingling of Natures."

[21] *Ibid:* "The Memory of Earth."

[22] *Ibid: "The Architecture of Dream."*

already been observed, will make a likeness of a cobbler;"[23] and "that poetry and mythology are, in some cases, wholly imitative."[24] Plato's thought was not tied to a narrow identification of art, even of most prominently representative art like painting, with imitation; but it was very obviously determined by the conception, so naturally adopted in the first instance, of art as skillful copying. Hannay observes that primitive art, like the art of children, attempts to put a line round a mental conception more than it endeavours to represent what the eye perceives.[25] But it is always difficult to understand what we really do and it was probably inevitable that aesthetic theory should begin by comparing painting, and even poetry, to copying or imitation. With an equal inevitability aesthetic theory could not persist in this inadequate description of art: Plato's own thought constantly burst through its confining bonds. The core of truth in the imitative theory of art, for artistic expression does employ the representative element of imitation, does, however, continually maintain a sympathy with Burke's dictum:" in the imagination, besides the pain or pleasure arising from the properties of the natural object, a pleasure is received from the resemblance which the imitation has to the original: the imagination, I conceive, can have no pleasure but what results from one or other of these causes."[26] Explorative thought, however, because it is explorative, finally recedes from imitation as the constitutive element in art. "Why are we not always pleased," asked Sir Joshua Reynolds, "with the most absolute possible resemblance of an imitation to its original object? Cases may exist in which such a resemblance may be even disagreeable. I shall only observe that the effect of figures in wax-work, though certainly a more exact

[23] Jowett's Trans., *Rep.* 10, 600, 601.
[24] Jowett's Trans., *Rep.* 3, 394.
[25] "Photography and Art": *The London Mercury*, Jan., 1920.
[26] *Essay On the Sublime and Beautiful*, Introd.

representation than can be given by painting or sculpture, is a sufficient proof that the pleasure we receive from imitation is not increased in proportion as it approaches to minute and detailed reality; we are pleased, on the contrary, by seeing ends accomplished by seemingly inadequate means."[27] Sir Joshua's discourses definitely transcend the identification of art with imitation. "If we suppose a view of nature represented with all the truth of the camera obscura, and the same scene represented by a great artist, how little and how mean will the one appear in comparison with the other, where no superiority is supposed from the choice of subject. The scene shall be the same, the difference only will be in the manner in which it is represented to the eye. With what additional superiority then will the same artist appear when he has the power of selecting his materials as well as elevating his style?"[28]

Mandeville, some fifty years before, still described painting as an imitation of nature, as a "happy deceit" possible through imperfections of sense; and ingeniously, though perversely, suggested that reflections from polished bodies were the first cues to the invention of painting.[29] The seduction by the element of counterpart in drawing, sketching, sculpturing or narration, by the representative substratum in art, into identifying art with imitation is hard to resist and difficult to expel. Fidelity in portraiture is still a popular criterion of a picture and it was for long a canon of more reflective opinion. The simulation by the visual mental image, by the mental picture, of outer things, analagous to the simulation by a painting of the scene it represents, has seduced thought into psychological and philosophical conceptions analagously to the imitative theory of art. The identification of artistic conception with

[27] Eleventh Discourse.

[28] Thirteenth Discourse.

[29] *A Search into the Nature of Society.*

the picture, with the painted image, with the representative sculptured form, with the imitative element in description or narrative, has a natural parallel in the identification of thought with mental image. No one of these indentifications has ever been absolute: reflective minds cannot constantly and consistently regard all artistic conceptions solely as imitations, neither can they continuously suppose an inclusion of all thought in mental imagery. But in both instances a fundamental, dominant prepossession has perpetually infected thinking: artistic conception, on the one hand, has been constantly confused with the picture which embodies it, and the mental image, on the other, has been systematically confounded with the process of thinking it subserves.

The mental image often has a valuable transcriptive function: visualising memory is a mental convenience for the blind-folded chess-player; pictures have frequently a photographic value for those who have lived among the scenes they represent or who desire to realise those scenes; and Burke rightly says that "a pleasure is received from the resemblance to the original." So also it is pleasant simply to have mental pictures of the past. Mere imitation has its pleasures and it has its uses. But exclusive preoccupation with the mental imitative picture or visual image, like persistent centering on the imitative in art, leads to confusion, mystification and error. Some modern tenders of the fires of art protest against the prerogative of imitation by destroying all semblance, in their pictures, to anything in earth or heaven. The mind has done with its imagery, in its own way, what these enthusiasts have done with their pictures. Let any one who is not habitually or preeminently a visualiser, perhaps even then, recover by memory and inspect with attention his mental imagery during a process of thought. He will not usually discover a visualised duplicate of any outward scenes nor an

ordered, mentally imaged version intelligibly reconstructed from such scenes. His imagery, simply as a collection of images, will be a kaleidoscopic chaos. The images themselves will normally be sketchy, shadowy, vague and undefined—mere ghosts of their physical prototypes. The following passage from Burke well expresses the disintegrated spread of imagery through most thought—dissolved in the mental process like salt in water. "If I say, 'I shall go to Italy next summer' I am well understood. Yet I believe nobody has by this painted in his imagination the exact figure of the speaker passing by land or by water, or both; sometimes on horse-back, sometimes in a carriage; with all the particulars of the journey . . . it is not only of those ideas which are commonly called abstract, and of which no image at all can be formed, but even of particular, real beings, that we converse without having any idea of them excited in the imagination; as will appear on a diligent examination of our minds."[80]

It is probable that many dreams essentially raise up before consciousness, into a more vivid realisation, the disbursed and depressed imagery involved in a sequence of thought. Titchener tells us that he habitually receives, when thinking of modesty, a "visual hint" in a visual image of a graceful, bending female form.[81] If he thought of one of his students, "Mr. Smith should be more modest," his mind might, during the night, confer upon the mental images involved the perceptive status of a dream. Mr. Smith would appear in the dream in person, since the mental picture of his person would carry Titchener's thoughts about him; modesty would appear in the guise of its "visual hint"—a modest young lady. Thus a dream of a somewhat sentimental meeting might result from a prominence in consciousness given to the imagery of a

[80] *Essay On the Sublime and Beautiful*, 5, 5.

[81] *Lectures On the Experimental Psychology of the Thought-Processes*, Chap. 1.

thought. The illusion inherent in the dream would depend upon diverting the mental images from their proper function as devices for thinking to imitations of real events. If dreams do so arise, whether at times or always, they intimate to us, by our false reactions to relatively vivid images as if they were realities, how shadowy our normal imagery is, and frequently, by their wandering or by their eccentric combinations, how chaotic is the imaginative part of thought. Rivers thinks the visualising habit is stronger among primitive and more degenerate among civilised peoples. The pulverising of mental imagery as development proceeds warns us off false estimates of the image, as modern chaoses in paint seek to divert mistaken emphasis on the imitative in art.

The tendency to consider mental imagery as essentially imitative, as a collection of photographs, instead of realising that the mind more resembles, in Titchener's phrase, a picture gallery of impressionist notes, long confused discussions on General Ideas. We certainly have general ideas for we can speak or think of "man" in a general sense and "animal" is as intelligible with a universal as with a particular significance. The capable thinkers of the past were not entirely in the dark but their mental vision was obscured by a confusion between "idea" or "thought" and "mental visual image." A mental picture of a horse is individual or particular; it may, however, assist the mind to think about horses in general: it may *refer* to all horses though it only portray one. Mental imagery, visualisation, before it produced this perplexity, apparently had a previous effect of hindering any formation of general ideas at all: before puzzling philosophers about the nature of general ideas it prevented them from acquiring them. Many observers have noted that primitive people tend to identify a drawing or picture of any animal with a particular individual. Wernlé says, for example, that East African

natives always draw particular crocodiles, never representing crocodiles in general by a picture of one. An English child soon understands that a picture of a canary in its animal book represents many canaries; the East African identifies a picture of a crocodile with the one he saw yesterday or with the one which ate his grandfather.[32] Visual mental images tend to persuade the mind, as pictures of crocodiles persuade East African natives, of the presence of some particular things or scenes. Dreams indulge this tendency by convincing the dreamer that he is in a boat or pursued by a tiger or falling through a window. The natural mental tendency, insistent in primitive identification of pictures of crocodiles with special crocodiles and emphatic in persistent comparison of the visual mental image with an attempt to reproduce reality completely, to regard all representations merely as reproductive facsimiles resulted naturally in supposing art to be imitation and in erroneous notions about the function and nature of mental imagery.

Berkeley could realise that a picture of a crocodile need not refer to the particular crocodile that he happened to have seen the day before but he had difficulty in understanding *how* an individual mental image need not represent only a single individual. "The idea of a man that I frame to myself," he writes, "must be either of a white, or a black, or a tawny, a straight, or a crooked, a tall, or a low, or a middle-sized man, I cannot by any effort of thought conceive the abstract idea of man."[33] Hobbes also considered it erroneous to speak of the idea of anything as universal because there cannot be in the mind an image of a man which is not the image of some one man.[34] The fascination of the mental image, its obstrusiveness, per-

[32] *Native Life in East Africa.*

[33] *Principles of Human Knowledge,* Intro. 10.

[34] *Elements of Philosophy,* 1-3.

sistently induced mental confusion by persuading men to identify imagery with thinking. In a parallel fallacy art was supposed to be imitation by mistakenly identifying *picture* with conception.

A day by the sea-shore is pictured, five years after, in memory. No particular emotion prominently connected itself, at the time, with the events of that day. The time was filled with action—with walking, bathing, conversation and the detail of life's round. No action is invited by the remembrance, which, in place of it, instals the reminiscent mood. The peculiar emotion characteristic of reflective reminiscence, springing from the memory of past scenes, differs from the feelings excited when those past scenes were real. Living through an event and remembering it are two different experiences and have their own separate emotional accompaniments. If memory literally reinstated the past it would restore a moment of time to its original being. But the function of mental imagery, even in memory, where duplication of the past event is most complete, is not to imitate but to present for thought. The more perfectly imitation is secured, for mental imagery often alludes to its theme by employing an element of imitation, the less perfectly is imagination's office discharged. Insistently imitative or reduplicative images hallucinate and destroy rational thought by falsely simulating reality, as dreams delude us into mistaking the imaginary for the real. "The truth is, if poetry gives us a noble assemblage of words corresponding to many noble ideas which are connected by circumstances of time or place, or related to each other as cause and effect, or associated in any natural way, they may be moulded together in any form, and perfectly answer their end. The picturesque connection is not demanded; because no real picture is formed;"[35] it took longer to perceive that what Burke here realises to be true

[35] *Essay On the Sublime and Beautiful*, 5-5.

of poetry may also be true of painting *viz.* there need be no "picturesque connection," no imitation. Art is not mere imitation, nor necessarily imitation at all, for the same reason that mere visualisation, simple portrayal, complete duplication, is not the essential function of mental imagery. Mental images resemble real objects, when they discharge their unperverted or primary function, only sufficiently to direct the mind to the themes they subserve—only sufficiently to secure adequate allusion. They can allude adequately without being directly representative at all: words, which can appear as mental visual images, have no claim to be considered imitative. Accurate visualisation has subsidiary uses: reading off memory manuscripts is a convenience and accurate reproduction in memory may recover significant fact. But mental imagery has for its chief use the impressing of past experiences into the service of thought.

The possibility of an impressiveness in the symbol superior to the impressiveness of the thing symbolised is obviously inherent in the essential function of mental imagery. The memory picture of a past event is a symbol of that event. The emotional reaction to the reminiscent symbol may be greater, and often is greater, than to the event symbolised because the symbol does not require the practical reaction, the actual living towards, demanded by the reality. An external symbol may resemble the mental image in freely admitting emotional reaction by suppressing the need for the customary habitual reactions of life.

Art takes advantage of this principle. Imitation, pure and simple, would tie it to a poor repetition of the actual. By transcending the imitative art secures another value which may be richer than the value of actuality itself.

JOSHUA C. GREGORY.

BRADFORD, ENGLAND.

CRITICISMS AND DISCUSSIONS.

ON THE LOGICAL INTRODUCTION TO THE THEORY OF FUNCTIONS.[1]

It seems as though it would still be premature to pronounce definite judgment on the results obtained by logistics, to attempt immediately to draw up, as it were, its scientific balance-sheet. Many questions that come under the logistical doctrine have not yet been solved, and one of the most important works by Whitehead and Russell, a work which must contribute to the establishment of this branch of science, has been announced, though it has not yet been published.[2] Notwithstanding this, it may not be without interest to recapitulate certain points in the discussion which has recently been raised along these lines between mathematicians and logicians, and to attempt to deduce some conclusions therefrom.

This controversy had a metaphysical point of departure. The first thing was to find out what element of intuition and of logic there was in mathematical reasoning. Kant regards intuition (*Anschauung*) as a mode of thinking which involves sensibility; in his philosophy, the determination of the nature of this intuition is of supreme importance, since, in his system, analysis of the elements of knowledge is essential. The investigation, however, which aims at determining the precise characteristics of intuition and the relations of this intuition to thought in general, constitutes a transcendental speculation, which could not be the real object of debate, the theory of intuitionistic metaphysics being no more susceptible of proof than that of the intellectualistic metaphysics of logisticians. In these matters, the argumentations of the most learned mathematician have no greater value than the discourse of the most ordinary philosopher,

[1] [Authorized translation by Fred Rothwell from "Sur l'Introduction logique á la théorie des fonctions," *Revue de Métaphysique et de Morale*, Vol. XV, 1907, pp. 186-216.]

[2] [Whitehead and Russell's *Principia Mathematica* began to be published in 1910 and is not yet complete.]

for the very reason that the mathematician no longer thinks as a geometrician but as a metaphysician. The problem, stated in scholastic terms, admits of no solution.

Nevertheless, what seemed to constitute the interesting element in this philosophical debate, was that the existence of a scientific theory, or at all events of a doctrine which offers a positive character, appeared to be connected with its solution. If intuitionism is the true doctrine, the works of Boole, Schröder, Frege, Peano, Whitehead and Russell must disappear; if logical intellectualism expresses true philosophy, the works of the logisticians are justified. Well then, in our opinion there is no solidarity at all between the metaphysical controversy, to which we have just alluded, and the question as to whether this special science called logistics has a solid foundation or not: the existence of logistics no more depends on controversies as to the nature of mind than the legitimacy of experimental physics is connected with discussions as to the inmost essence of matter. No doubt certain logisticians have attributed excessive importance to their own science, and, in a sense, have transformed it into scholasticism; this metascientific extension of a positive doctrine is illegitimate and raises insoluble antinomies. But we believe there to be a scientific and restricted conception of logistics, which is free from the fluctuations of philosophic thought: we will attempt to prove this theory shortly. Before entering into this essential point, we must remember that the constitution of logistics is in conformity with the meaning of the evolution of the sciences, and, without entering into many historical details, a few brief indications will enable us to justify this affirmation.

It is known that the works of Cauchy and Abel are at the root of the development of analysis in the nineteenth century, and that logical precision and rigorous demonstration characterize the work of these great geometricians. In 1826, Abel wrote to Hansteen: "I shall devote all in my power to bring light into the vast darkness now reigning in analysis.... In higher analysis, very few propositions are demonstrated with strict rigidity. Everywhere we find that unfortunate method of inferring from the special to the general...."[3] This need of strict demonstration corresponded to logical requirements, to the necessity of reducing as far as possible the approximations of the imagination of inventors. Cauchy and Abel have contributed largely to the acceptance of the principle—now undisputed

[3] Abel, *Œuvres*, Sylow and Lies edition, II, 263.

—that no propositions in mathematics can be accepted unless it has been fully demonstrated. The geometricians of the eighteenth century, however, less exacting than modern mathematicians, were satisfied with methods the exactness of which left much to be desired, since for the most part they trusted to their intuition.[4] Suffice it if we recall the erroneous conception of divergent series, of Euler's series, for instance,

$$1-1+1-1\ldots.$$

As the sum of this series is alternately 1 and 0, according as we take an odd or an even number of terms, the geometricians of the eighteenth century regarded it as natural to take the arithmetical mean of 1 and 0, i. e., ½, as the sum of the series. This reasoning, however, is inexact, "for it is easy to form series the terms of which depend on a variable, and which reduce to Euler's series for a particular value of this variable, in such a way that the limiting value of the series is absolutely any number whatsoever."[5] The geometricians of the eighteenth century employed divergent series because these series were successful empirically; they did not trouble about the logical difficulties which the series might raise. What we have just said regarding divergent series would be equally correct regarding many other branches of mathematics. Here again we would refer to the transformations in the definition of the integral. Analysts, from the time of Cauchy and Dirichlet, have endeavored to substitute, for the confused notion of the integral considered as an area, a rigorous analytical definition. Riemann's works throw light on the matter, whilst the results obtained by Henri Lebesgue at the present time must be mentioned. Here too, exact analytical definitions are substituted for vague intuition. We may therefore say, confining ourselves strictly to historical truth, that the analysis of the eighteenth century was far less rigorous than that of the nineteenth, and, unless we assert that the results of the nineteenth century are inferior to those of the eighteenth, we must acknowledge that the entire evolution of mathematical science points to progress along the lines of a greater logical precision.

The affirmation of Pierre Boutroux that "it is frequently advantageous, in the theory of functions, to substitute for the study

[4] We use the word "intuition" in its ordinary meaning. Intuition is a *rapprochement* made by the imagination, a *rapprochement* that is not tested by logical criteria.

[5] Borel, *Leçons sur les séries divergentes*, p. 6.

of a development that of less precise and more *intuitive* characters,"[6] must be understood as meaning that, in research, it is convenient to employ less rigorous methods; though unquestionably the results obtained, before being definitely incorporated in science, must be verified by the most exact methods. To assign any other meaning to this affirmation would be to deny the entire development of modern mathematics.

Ever since the progress of mathematical methods consisted in attributing an ever greater part of logical rigor and precision, we had to examine the very foundations of the reasonings of geometricians, to analyze the fundamental types of demonstrations, and to establish the indefinable elements on which these demonstrations are based. Logistics, therefore, was in conformity with the spirit of the works of Cauchy and Abel. Still, though the historical development of mathematics certainly seems to prove that logistics is legitimate, *de jure*, at all events, how far can it be said that the logical reduction of mathematical reasonings is accomplished *de facto?* Do the nine indefinable and the twenty indemonstrable propositions of Russell constitute the whole logical framework of mathematics? These are questions to be examined in detail. It seems that there are problems which Russell has solved and others in which he has failed; it would scarcely be reasonable to expect him, unaided, to build up the whole of logistics. Note, moreover, that Russell would appear to be mistaken as to the import of logistics when he says: "The fact that all mathematics is symbolic logic is one of the greatest discoveries of our age."[7] It seems, however, that he himself restores logistics to its true import, when he regards it as a sort of speciality,[8] a branch of mathematics, unknown indeed to the majority of mathematicians, and not the indispensable instrument of all mathematical investigation. What are the exast limits of this new branch of mathematics? What is its positive function, and what are its relations to the great mathematical theories, especially the theory of functions? These are the questions that have to be answered. They are weighty problems, however, and we do not pretend to solve them in the following pages. We will confine ourselves to emphasizing certain points.

[6] Pierre Boutroux, *Thése sur quelques propriétés des fonctions entiéres*, p. 1.

[7] Russell, *Principles of Mathematics*, 1903, p. 5.

[8] Russell, *Revue de Métaphysique et de Morale*, Sept. 1906, p. 628.

I. THE GROUND COVERED BY LOGISTICS.

We will at the outset attempt to give a few indications as to the determination of the limits of the domain of logistics. It must have boundaries in the sense of metaphysical abstraction (a upper limit if you like), signifying that it must, by an explicitly formulated postulate, put a stop to all digressions in the barren domain of scholasticism.[9] It must likewise have boundaries as regards its applications (lower limits), or, if you will, its extension to the domain of positive sciences, in order to avoid clashing with existing methods. We shall take for our starting point Whitehead's definition of a calculus in general. A calculus is defined as "the art of manipulation of substitutive signs according to fixed rules, and of the deduction therefrom of true propositions."[10] According to this meaning, still a very vague one, a calculus may apply to two kinds of mathematical entities: *non-numerical* and *numerical*. These two kinds of entities differ in the fact that the former verify the following laws:

$$a=aa$$
$$a=a+a$$
$$a+ab=a;$$

whereas the latter satisfy the well-known rules:

$$aa=a$$
$$a+a=2a$$

(we give these rules only in order to state exactly what we think, we do not mean that the elementary laws governing the operations of ordinary arithmetic can be applied to all numerical mathematical entities).

The field of a calculus, comprising both numerical and non-numerical entities, contains all possible forms of thought: according to this general sense, then, logistics is a calculus.

But with regard to a calculus in general, there may first be asked the necessary philosophical question: what relation does reality hold to rules and to substitutive symbols? In our opinion, a problem thus stated has no scientific meaning, hence, whenever problems of this kind are asked, we may neglect them. In doing so, however, by a tacit postulate we confer absolute value on the logico-mathematical laws, we apply to them the idealistic principle (the laws of mind are

[9] Those who regard this precaution as unnecessary have only to read the articles on this subject in the *Revue de Philosophie*.

[10] Whitehead, *Universal Algebra*, p. 4.

the laws of things) which others apply to metaphysical principles and we thus put a stop to all wandering from the point in the field of scholasticism, as well as to questions which admit of no reply, such as the following: what is the objective value of symbolism? We should not have dwelt so long on this matter, had not Louis Couturat, an authority in questions of logic, affirmed that speculative philosophy comprises "in addition to the methodology of the sciences, the epistemology or criticism of the principles of the sciences, the general theory of knowledge, and finally metaphysics as the science of being, so far at least as this latter is known and knowable, and is conceived in its relations to the mind.[11] Now, if the methodology and the epistemology of the sciences are legitimate, it appears to us erroneous to affirm the justification of a theory of knowledge and of a metaphysic. Having already explained our position on this point, we will not dwell on it any longer.[12]

It remains for us to determine the lower limit of the field of application of logistics, a far more delicate task, for it does not appear as though we could yet obtain any definite results from the controversy on the subject. The problem is stated in the following general terms: apart from a certain domain proper to it, which Hadamard defines as that of the analysis of mathematical reasonings[13] and which we shall presently attempt to determine a little more explicitly, should logistics extend, as a new general method, to the different parts of mathematics? Is there a time when the logistician must give way to the mathematician or can they both travel together? Is logistics, in every respect, a *substitute* for mathematics? If Peano has not fully adopted the latter alternative, he at least seems to regard logistics as a new algebra. "He uses it," says Jules Richard, "*as algebra is used* for stating propositions and deducing them from one another according to fixed rules. As I could prove by numerous quotations, he has never thought of making up for the primary notions of science, that of number, for instance, by this algebra."[14] But does not this mode of regarding logistics imply an illegitimate extension of its field of applicaton? The argument that merely says that the *Formulaire* exists,[15] i. e., that it is in print, is of no great importance. The request to the opponents of logistics to find errors

[11] Couturat, *Revue de Métaphysique et de Morale*, May 1906, p. 340.
[12] *Revue de Métaphysique et de Morale*, July, 1905.
[13] Hadamard, *Revue générale des Sciences*, 30 Oct., 1906, p. 909.
[14] J. Richard, Ibid., 30 Nov. 1916, p. 957.
[15] Couturat, *Revue de Métaphysique et de Morale*, March 1906, 220.

of demonstration in the *Formulaire*[16] is certainly more serious, though it does not remove the main objection. If logistics, when it takes up the work of the mathematician himself, is but a *translation* into other signs of ordinary mathematical reasoning, as it is accused of being, then it can make mistakes only if the original reasoning has made mistakes, in this case, logistics is blamed not for its falsity but for its *uselessness*: a method having justified its existence either when it permits of the solution of problems not previously solved, or when it is more precise and rapid than existing methods. The logistical method has not provided a solution of problems strictly mathematical and not previously solved, nor can it lay claim to rapidity; so that it remains to be seen whether, in the strictly mathematical domain, not only in the domain of the principles of mathematics, it possesses qualities of exactness which the standard methods do not possess, by explicitly formulating all the postulates which are mostly used unconsciously.

As a matter of fact, say the logisticians, the reason why the mathematician is not mistaken is because he is guided by unconscious logic. Let us see, then, in the most elementary of examples,—the arithmetical addition of integers,—if there is room for the intervention of logistics in the strictly scientific domain. We will leave out of account the questions on principles (definition of number, etc.), since, from our point of view, these come under the heading of logistics.

The operation $+$ will be characterized, as in all treatises on arithmetic, as a primitive operation having the four properties:

1° Of being associative;

2° Of being commutative;

3° Of having zero for its modulus;

4° Of being such that, if to a number a we add numbers differing from one another, we still obtain numbers differing from one another.

Everyone knows that these properties were formulated long before the existence of logistics. Suppose the system of numeration determined, as well as the rules for writing numbers in the chosen system (we refer to treatises on arithmetic for details of three rules) and that we have to add together $5+7+(3+4)=19$. Will the rules established by arithmetic enable us to avoid all error? Are mistakes avoided by virtue of an unconscious logic or by virtue of the rules

[16] *Ibid.*, p. 221.

of arithmetic? In a word, does not arithmetic itself use logic? And is not all error in calculations of addition impossible when we correctly apply the rules of arithmetic? Is not the intervention of a logical calculation, in verifying the correctness of the operation, supererogatory?

We do not think there can be any doubt on the matter. If our example is regarded as too simple, the same question may be asked in the case of trigonometrical calculation. At the outset, we may introduce the trigonometrical functions sine x and cosine x in the way indicated by Jules Tannery so as to reduce experimental data as much as possible: "We also establish from geometrical considerations the formulas:

$$\alpha \begin{cases} \sin\ (a+b)=\sin\ a\ \cos\ b+\cos\ a\ \sin\ b. \\ \cos\ (a+b)=\cos\ a\ \cos\ b-\sin\ a\ \sin\ b \end{cases}$$

I will show (taking their existence for granted) how we may determine all the continuous functions $\phi(x)$, $\psi(x)$ which have preperties defined by the formulae:

$$\beta \begin{cases} \phi(a+b)=\phi(a)\phi(b)-\psi(a)\psi(b) \\ \psi(a+b)=\psi(a)\phi(b)+\psi(b)\phi(a) \end{cases}$$

and likewise satisfy another condition.... Designating by cos x and sin x functions which are known to be continuous and which must satisfy the equations (α)....we must have the relation

$$(\gamma)\ \sin^2 x+\cos^2 x=1" \quad [17]$$

The functions sin x and cos x are determined by formula (α) and (γ). Considering the functions sin x and cos x as given by their developments in series; it may be shown how these functions effectively satisfy the conditions with which we started. Without taking up the demonstrations in every detail, we see that here is a starting point for a rigorous establishment of the formula of elementary trigonometry.[18] By strictly keeping to the rules thus obtained, we may be certain that we shall never make mistakes in any particular trigonometrical calculation. It will not be unconscious logic, but a literal application of the formula that will have enabled us to avoid mistakes. Moreover, as all the reasonings of algebra, analysis and geometry are as rigorous as those just mentioned, and are all ob-

[17] J. Tannery, *Introduction á l'étude des fonctions d'une variable*, First edition, p. 146.

[18] *Ibid.*, p. 157.

tained by the ordinary rules of calculation, it is not clear what useful a part logistics is capable of playing within the particular domain of these different sciences.

Perhaps Peano and his collaborators had the impression that, by confining themselves to the determination of the grammatico-logical principles of mathematics, logistics would constitute no more than a limited speciality, and as the idea of a new general method was probably continually in their minds, they have included in the *Formulaire* a number of pages which, strictly speaking, ought not to be there. As an instance, amongst many others which might be mentioned, we will refer to pages 35, 40 and 41 in volume V of the Formulario matematico....

Speaking generally, we do not see what practical algebraical calculation is to gain from these evident remarks. From the beginning of algebraical calculation, strictly so called, *the rules of this calculation have become the logical rules*, and no further search is required. To teach the first elements of calculation, however, phrases have had to be employed; indeed, it would be impossible to explain the beginning of mathematics without a preliminary grammatical discourse. "The study of grammar," writes Russell, "is in my opinion capable of throwing far more light on philosophical questions than philosophers generally suppose."[19] Thus we meet with Peano's signs for implication, conjunction, belonging to a class, etc. These signs are substitutive for fundamental ideas. How are we to characterize these ideas, how employ them, and how do they relate to mathematics, properly so called? These are questions to which a reply must be given and which must be treated with the same precision as mathematics itself, if we would prevent the beginnings of arithmetic, analysis and the other branches of mathematics from being lost in mist and fog.

Russell has already thrown considerable light on these questions in Chapter V of the *Principles of Mathematics* which deals with denoting. He brings forward the part played by the words *all, every, any, a, some, the.*[20] As we cannot imagine the state of a man's mind from which all grammatico-logical notions were banished, the very principle of all positive philosophy compels us to study these notions as given facts, to set up the laws of the combinations proper to them, as well as the relations which unite them to mathematical science

[19] Russell, *Principles of Mathematics*, p. 42.

[20] There has since appeared an article by Russell in *Mind* (Oct. 1905) on the question of denoting.

ings (the principle of composition, of simplification, of contraposition, of exportation, of importation, of deduction, of substitution, principles of the logic of relations....) the inanity of which would have to be shown before we could affirm the supremacy of the principle of complete induction. Moreover, it is clear that, if we give the name of complete induction to the faculty possessed by the human mind of forming general judgments, valid for an infinite number of cases, such a principle intervenes in every act of thought. There is nothing legitimate about this denomination however. It would appear that the method of complete induction strictly speaking, must only be used in its own proper domain (the theory of finite numbers) and in the cases related more or less directly to this domain. It appears, then, that the logisticians must finally win as regards the principle of complete induction, the problem being distinctly within their province, since we have to analyze a mathematical reasoning.

To sum up, however sarcastically logistics be regarded, it is a positive domain of investigation, an ensemble of questions to which answers must be given. Still, while we cannot ignore this branch of science, it would be equally erroneous to imagine that the essential of mathematical thought has been absorbed in the general theories of logistics and to think that all the other branches of mathematics are reduced to an automatic application of the rules laid down in the logical introduction. Even admitting, as we do, the justification of logistics, though circumscribing its domain very precisely, the absolute autonomy of mathematical thought must be acknowledged. What we mean is that, even if the general questions of logic were solved to the satisfaction of all, the difficulty of the real problems, which we find in pure mathematics or which the physicist asks the calculator, would be in no way lessened thereby. To parody a famous motto, we might say: Logic is well established, now begins the era of scientific difficulties.

In the two following paragraphs we will endeavor to set forth a few examples of problems to the solution of which logistics brings no light or help of any kind; thus we shall determine more positively what we have called its lower limit.

II. ON THE DEFINITION OF IRRATIONAL NUMBER AND ON THE GENERALIZATION OF NUMBER.

In one article, we could not dream of examining in succession all the theories of logistics. We will content ourselves with taking, as an example, the definition of irrational number set forth in

chapter XXXIV of Russell's *Principles of Mathematics.* We will sum up what Couturat says of Russell's results: "His definition consists in identifying the irrational number with the *lower class* which previously served to define it.... We will give the name of *segment* to every not null class of rational numbers, which does not comprise all rational numbers, which comprises all rational numbers smaller than any one of its elements, and such that each one of its elements is smaller than another of its elements."[27] These last two conditions may be expressed in symbols. It is shown that there are more segments than rational numbers. "These segments, by definition, will be the real numbers."[28] The irrational numbers has been identified with the lower class.[29] Does this laboriously obtained definition, after criticism of the many definitions of the irrational number, throw the faintest light on the strictly mathematical difficulties which come under the tneory of these numbers? By no means, as we shall at once show.

How far have the preceding definition and the different logistical theories dealing with the irrational numbers helped to solve the following problem?

A number being defined by an infinite succession of integers, to find whether this number is commensurable or incommensurable.[30] True, it is known that if a number is defined by its expansion in decimals, for the number to be commensurable it is necessary and sufficient that the series should be periodic from a certain number onwards. It is also known that if the number is developed in a continued fraction, in order that it may be commensurable the development must be limited. These rules, however, do not solve the general problem.[31] This is not all, the logistical theory does not permit us to recognize whether a definite incommensurable number is algebraic or transcendental, and in case it is algebraic to determine its degree.

As regards more especially transcendental numbers, their existence is by no means evident *a priori*, it results, as it known, from

[27] Couturat, *Les Principes des Mathématiques*, p. 85.

[28] *Ibid.*, p. 86.

[29] We might also identify the irrational number with the higher class.

[30] We shall use without distinction the terms "incommensurable" and "irrational," though both alike are defective. As a rule, the term "incommensurable" is used for dimensions.

[31] E. Cahen, *Eléments de la théorie des nombres*, p. 172 and p. 183.

a theorem of Liouville: p/q being an irreducible fraction, value approaching ξ, if we have

$$\text{Mod. } (p/q-\xi)<1/q^{n+1}, \text{ since}$$

the values of q transcend all limit, ζ cannot be an algebraic number of the degree n. If we can prove this for each value of n, ξ is transcendental.[32] Thus the existence of ζ demands a particular demonstration. We may add that, as regards algebraical numbers, there is a theorem of Lagrange which enables us to know when they are of the second degree. Any reader desirous of studying these questions more deeply will find important results in Edmond Maillet's work on the theory of transcendental numbers.[33] Especially do we draw attention to the theorem which supplies the necessary and sufficient condition for an irrational, positive, real number to be a transcendental number of Liouville.[34] In these investigations no mention is ever made of the formula of logistics. In a word—and it is all we wish to remember of the foregoing explanations—the logistical definition of the irrational and the considerations that logisticians may have advanced regarding it, whether put in formula or not, throw no light whatsoever on the determination of the distinctive characters of the commensurable and incommensurable numbers, of the algebraic incommensurables of the different degrees and finally of the transcendental numbers. In these matters, the results have been obtained by attacking the difficulties directly by the ordinary mathematical methods. Along these lines, we may add that there is much to be done.

It would be fastidious to mention all the main problems not solved by the ordinary methods, and for which logistics gives no help at all to the mathematician. As an example, we will cite the following case found in analysis. "It is known that two functions, which always have the same derivative, differ only by a constant, when this derivative is *finite;* as regards the general case, nothing is known"[35] or, along a totally different order of ideas, we will recall one of Fermat's enunciations, unsolved in the general case: the equation $x^n+y^n=z^n$ is not resolvable into integers for $n<2$. We must not

[32] Borel, Leçons sur la théorie des fonctions, p. 26.

[33] Maillet, *Introduction á la théorie des nombres transcendants,* 1906.

[34] *Ibid.,* p. 124.

[35] Lebesgue, *Leçons sur l'intégration et la recherche des fonctions primitives,* p. 75.

[36] Couturat, *Les principes des mathématiques,* p. 79.

forget, however, that we are writing in a philosophical review, and so we would rather examine a question of a more general character: the generalization of number will enable us to make a few interesting remarks. "The same logical method," writes Couturat, "enables us to explain the generalization of number. First, the rational numbers will be considered as relations between integers. . . . The positive and negative numbers also will be conceived of as logical theory of irrational numbers requires the previous study of the continuous, just as the logical theory of complex numbers presupposes the theory of space.[37] Logistics finds no serious difficulty, so long as it does not more than justify and organze the numbers, or, more generally, the mathematical entities which positive science has adopted. When we are dealing with new entities, however, the scientific use of which is still disputed, it does not appear as though logistics could afford any very effective help in the solution of the questions, so true is it that the introduction of the new entity is mainly justified by the mathematical use to which it is put. First and foremost, logic has no general process of generation for all possible entities—moreover, it seems as though experiment (for instance, the measurement of certain physical dimensions) plays an important part, at least as regards the origin of the new entities. Consequently, whenever a new entity obtrudes upon the attention of scientists, the question that is first asked is whether it is reducible to the known entities, and only special study in mathematics can afford us profitable information on this point. If logistics possessed a restrictive general principle (or a small number of such principles) which the new entities must verify, it would have a simple logical process which would permit of some of them being eliminated. It was thought that Hankel's principle of the permanence of the rules of calculation had this property; but, by a strange irony. it was the logisticians who pointed out that this was not so. This principle, remember, may be formulated as follows: "If, for the purposes of generalization, we can give up some particular property of an operation, we must on the other hand take care not to add any new property to those already used in the restricted operation, so that any rule set up for the generalized operation may also be applicable to the restricted operation."[38] To say that this principle is false means, in a word, that it is not possible to fix for the arithmetical operations general characters valid for all classes of numbers, and more generally for all classes of

[37] *Ibid.*, p. 81.

[38] Houël, *Cours de calcul infinitésimal*, I, 5.

mathematical entities, since each particular class of entities has its own distinctive operative laws. But then, such reasoning as that of Weierstrass, for showing that any hyper-complex number of an ensemble with n units "is decomposable into r complex numbers belonging respectively to r partial ensembles with *one* or *two* units.... the ensembles with one unit being analogous to the ensemble of the real numbers....the ensembles with two units being analogous to the ensemble of the ordinary complex numbers,[89] a reasoning that is possible only on condition that we suppose the associativeness, the commutativeness, and the distributiveness of the multiplication of the new complexes, is still quite formally correct, though it loses all general philosophic bearing since Hankel's principle is false. The field, then, remains absolutely open to the creation of new entities which will individually have to be subjected to a special mathematical investigation. We may add that the relations of the entities with their operative laws have nothing fixed: certain numbers, such as integers, are reproduced by addition and multiplication but others (algebraic numbers of the second degree, for instance), generate numbers of a denomination different from themselves by addition and multiplication.

Of all the new theories, however, the theory of transfinite numbers is by far the most instructive to examine; for the reason that it contains a class of new entities on the bearing of which mathematicians are not agreed. What are the transfinite numbers which must be admitted? Those of the first two classes? Those of a higher class? Are not the *ordinal* types called to a greater future than the *transfinite cardinals?* Must we reject all these numbers *en bloc?* Mathematicians are not agreed, and logisticians, hitherto, have come to no positive result. Still, if we trust to what the history of mathematics teaches us, there is every ground for believing that geometricians, of themselves, will solve the difficult problems contained in the new doctrines. Indeed, the theory of imaginaries and hyper-complexes had given rise to logical or philosophical difficulties over which mathematical thought, without the help of foreign allies. has succeeded in triumphing. In all probability it will be the same with the transfinite numbers. Here we do not claim to go to the root of this problem; we simply state at the outset that the criterion of mathematical utility constitutes, provisionally at least, a principle of elimination which will probably cause many parts of Cantor's work

[89] Couturat, *De l'Infini mathématique*, note I, p. 587.

to be condemned. This criterion has been formulated by Picard in the following terms: "There will be occasion to develop it (the arithmetic of the transfinite numbers) only if these views prove to be fruitful in analysis; consideration of the transfinite numbers has already enabled us to discover certain theorems, though we must say that they might have been obtained by another method."[40] Nor must we forget to make a distinction—one which might escape the notice of philosophers—between the theory of *transfinite cardinals* and that of *transfinite ordinals*. As regards the first theory, the opinion of Borel would seem provisionally to sum up the question best: "The second principle of formation cannot make us acquire the notion of a power we had not already, and it appears doubtful whether we have any definite idea of what a power beyond the second can be.... It cannot, however, be denied that at the present time the expression *transfinitely* has still a less precise meaning than the expression *indefinitely*, the result being that our precise knowledge of the different powers goes scarcely beyond the following remark: there are numerable ensembles and non-numerable ensembles, the later notion being mainly negative."[41] The theory of the ordinal types seems called upon to play a more important part than that of the transfinite cardinals. In this connection, let us consider what led Baire to introduce the notion of transfinite ordinal: "In the same way, for well ordered ensembles, we think it may be advantageous, when fixing the notion of *rank* in such an ensemble, to attach a new term to this notion and proceed as though all the elements of a well ordered ensemble had ranks determined once for all. Now, we have seen that integers were inadequate for this purpose, we shall give them new signs which will be the transfinite numbers."[42] To sum up, it would seem that the determination of the definite balance of the theory of transfinites comes within the province of the mathematicians, and that certain results only of Cantor's theory, but not all, as Russell seems to think, may be retained. Moreover, the existence of logistics, from the above explanations, is in no way connected with the success of the whole of transfinitism.

[40] Picard, *La science moderne et son état actuel*, p. 56.

[41] Borel, *Leçons sur la théorie des fonctions*, p. 122.

[42] Baire, *Leçons sur les fonctions discontinues*, p. 41.

III. IRREDUCIBLE INTEGRALS AND THE NUMBER OF PRIMITIVE IDEAS.

We know that, in problems of quadrature, we are led to consider functions that cannot be integrated by means of algebraical expressions and elementary transcendentals (logarithm, exponential, circular functions) in finite number. Thus, we establish the existence of types irreducible to simpler forms. Then we say that there are new transcendentals. We cannot insist too strongly on the way in which mathematicians study these new entities.[43] The process we are about to characterize in a general way is of considerable philosophical importance, since the so-called chain of purely analytical deductions from mathematical propositions would seem at a given moment to be broken; supposing we are to imagine mathematical propositions as forming a chain. At a certain moment, we find mathematical entities which cannot be formally integrated by means of elementary forms in finite number. We do not on this account banish them from the field of analysis, but we study them as new objects with properties *sui generis*. They will have formulas of addition, multiplication, developments in series, etc., which are proper to them.

Take, for instance, the elliptic integrals which play a large part in analysis, and the question of the reducibility or irreducibility of differential equations....

These irreducible mathematical entities constituting a non-enumerable infinity, how are we to reconcile this fact with the logical theory according to which there is only a finite number of elementary ideas? Are we to say that these original mathematical entities, transcendental numbers, irreducible integrals, form a *progression*? The term progression, however, in the logistical theory, signifies a sequence similar to the sequence of the natural numbers. A finite number of indefinables and of indemonstrable principles suffices to constitute the unlimited sequence of the natural numbers and their elementary properties. (Of course, the logistical doctrine throws no light on the inner nature of these numbers, as we may see by studying the theory of prime numbers.) As regards the natural numbers, the elementary operative rules are permanent for the entire sequence. However large a natural number, even if it extends to a hundred digits, the laws of addition, substraction, etc., will remain the same

[43] To justify our conception there might be found other instances than the one we are examining. This, however, has the advantage of emphasizing the fundamental notion of irreducibility.

for it as for the prime numbers, unless we contest the value of the principle of complete induction. The ensemble, however, of the irreducible transcendentals cannot be regarded as forming a progression. First, the operative rules are no longer retained; for instance, there is a formula of addition for the elliptic functions which is not the same (although these formulas have analogies) as the formula of addition of the trigonometrical functions. Again, there is no *consecutiveness* between the elements of such an ensemble, such as there is in the sequence of the natural numbers. Finally, the power of this ensemble is not like that of the sequence of the natural numbers, the power of the ensemble of the irreducible mathematical entities constituting a non-numerable infinity. On the other hand, however, we cannot think with an infinity of logical principles. No doubt such notions as those represented in mathematics by the signs of an infinite sum, an infinite product, an integral, imply an infinity of elements, but as regards these notions we must agree with Russell and Couturat that they are thought in comprehension, not in extension. It must then be concluded that we think with a finite number of logical constants (indefinable notions, indemonstrable propositions) which enable us to study the transfinitely infinite universe of mathematical entities. We will sum up what we think regarding the number of the elementary ideas by saying that the system of our logical ideas constitutes a closed system, and that the universe of abstract and concrete entities to which it applies will always be for us an open system. But, for that very reason, the study of the universe of entities will never be completed, and it will force us to modify the closed system of the logical constants. We shall indeed be led to consider new irreducible entities, which will not necessarily come within our logical schemes; hence the need to perfect them. At a given moment of evolution, we always think with a finite system of logical constants; but one system succeeds another. Couturat has claimed the right, quite a legitimate one, to transform and improve academical logic, and has successfully refuted the extraordinary theory according to which logic alone, of all productions of the human mind, having its origin in the brain of Aristotle, constitutes an eternal and consequently divine monument. Just because logic, however, is subject to the general law of evolution, we cannot affirm that the logic of Russell, with its nine indefinables and its twenty undemonstrable propositions, possesses that character of perenniality which we rightly refuse to attribute to the work of Aristotle.

Observe that evolution may take place by way of adjunction—as is the case with mathematics. It is not necessary, as is erroneously imagined, that it should take place by way of contradiction (Hegelian theory). The multiplication table, the formulas of trigonometry, said to have been first formulated by Hipparchus and, dating back several thousands of years, have never been contradicted, never ceased to be true.

IV. THE NOTION OF FUNCTION AND THE RESTRICTIVE CONDITIONS FOR ITS USE IN MATHEMATICS.

In the last two paragraphs we have indicated mathematical theories which are opposed to an illegitimate extension of logistics outside of its field of application. Inversely, we must not restrict this field too much. It would appear as though Pierre Boutroux has gone too far along this line and refuses to logistics the exercise of a legitimate right. In the determination of the conditions that restrict the notion of function, he thinks he has found an extra-logical operation,[44] consequently, a limitation to the domain of logistics Later on we will examine more thoroughly this complex problem which raises numerous difficulties. In this short paragraph we will simply submit to the philosophers certain general results, which will enable us to make a few reservations as to the judgment of Pierre Boutroux.

It may be said that the most general notion of function is a discontinuous and nonuniform function. It is known, however, that analysis does not possess a theory of functions corresponding to this absolutely general type. Indeed, it is easy to show that we cannot at present set up a theory of the most general discontinuous functions. Let us follow Borel's reasoning: a continuous function may be given by means of a numerable infinity of conditions; it is *not* so with a discontinuous function in its most general meaning: such a function is defined by a ***non-numerable*** infinity of conditions; in practice, this is equivalent to saying that it is impossible to define it."[45] Consequently, we cannot think of approaching the theory of functions by allowing this notion to retain its greatest generality. Restrictions must be imposed on it.

Keeping to the notion of function, Lebesgue has retraced the history of the early transformations of this notion. We will briefly sum up his statement. At the time of Newton and Leibnitz, a

[44] P. Boutroux, *Revue de Métaphysique et de Morale*, July 1905, p. 633.

[45] Borel, *Leçons sur la théorie des fonctions*, p. 126.

function was generally called "a quantity y connected with a variable x by an equation, with a certain number of symbols of operations intervening (arithmetrical, trigonometrical, logarithmic operations.[46] Then, following on the problems of integration, we have been led to consider the case in which there is a geometrical relation between a function S (x) (*area*) and x. Afterwards, a distinction was made between "the geometrical figures defined with the aid of laws capable of being expressed by geometrical equalities and the figures that were not thus defined."[47] To the curves included in the first case corresponded the continuous functions (Eulerian continuity), to the curves of the second kind corresponded arbitrary functions which were not true functions." The continuous functions were the true functions."[48] Later on, Fourier overthrew this method of considering the functions, by showing that the "trigonometrical series which could be employed, in many cases, for the representation of continuous functions, might also be used for the representation of non-continuous functions formed of parts of functions."[49] Then Cauchy gives the following definition of function: "y is function of x when to each state of magnitude of x there corresponds a perfectly determined state of magnitude of y."[50] To Cauchy's mind, it was necessary that these correspondences should be analytical; later on, this restriction was removed. Without dwelling upon the important investigations of Riemann and the subsequent studies which have thrown light on this matter, we may mention summarily the results obtained by Baire. Baire asked himself what were the conditions which the discontinuous functions must satisfy to be representable by series of continuous functions. He first shows "that a function presenting *a finite number* of discontinuities is the limit of continuous functions."[51] In a more general way, he distinguishes the *punctually and totally discontinuous* functions, according as their oscillation has its minimum everywhere nil, or not.[52] (We know that the oscillation is the difference between the maximum and minimum values of the function in an interval.) He obtains the following theorem: "Every

[46] Lebesgue, *Leçons sur l'intégration et la recherche des fonctions primitives*, p. 1.

[47] *Ibid.*, p. 3.

[48] *Ibid.*, p. 3.

[49] Lebesgue, *Leçons sur l'intégration et la recherche des fonctions primitives*, p. 3.

[50] *Ibid.*, p. 4.

[51] Baire, *Leçons sur les fonctions discontinues*, p. 11.

[52] *Ibid.*, p. 75.

limit of continuous functions, is a punctually discontinuous function."[53]

After this too brief statement, we may say that the problem set by Boutroux is intimately connected with the history of the notion of function. Now, this history has never been specially and fully set forth. Consequently, so long as the equivalent of the historical work of Charles on the methods of geometry does not exist for the theory of functions, we cannot clearly deduce the part of real logic implied in the fundamental notion of function and in the conditions imposed on it. When Pierre Boutroux affirms that "the conditions by means of which we determine the idea of function have an indeterminate character, that they are not the known but the unknown quantity of a problem,"[54] or even that investigation into the conditions to be imposed on the functions constitutes an extra-logical operation, he adopts the point of view of discovery. First, however, the notion of function is with difficulty distinguished from that of *relation*, which seems to form part of those grammatico-logical notions mentioned at the outset of this study as forming part of the domain of logistics. Do not the most general conditions, at least, which we impose on the idea of function, also share to some extent in this logical character? We have just indicated the method which, by unfolding the historical origin and the developments of each notion, would in our opinion permit of a reply to this question; we cannot here develop it further.

V. CONCLUSION.

We will briefly sum up the conclusions drawn from this study.

Note first that the controversy, to which we alluded at the start, ceased to deal with the essential philosophical problems when it degenerated into an examination of the cases of mathematical *teratology*. The Burali-Forti antinomy, the Richard contradiction, the "All Cretans are liars" sophism are the extreme confines of the science. We do not deny that they are interesting, but there are more fundamental problems lying at the very heart of mathematical theories. To resolve to reduce the philosophy of mathematics to the solution of sophisms would be as unjust as to look upon pathological physiology as the model of all physiology. Now, the readers might have this impression on reading the latest discussions dealing with

[53] *Ibid.*, p. 83.

[54] P. Boutroux, *Revue de Métaphysique et de Morale*, July 1905, p. 628.

these questions. We may even go further and say that the elaboration of logistics does not involve all the difficulties which deserve to create reflection on the part of the critic of the sciences, and that there are real mathematical problems which give rise to philosophical questions of wide range.

Afterwards, we saw that logistics constitutes a restricted though indispensable branch of general mathematics.[55] Remember that Auguste Comte, who is usually quoted as an opponent of formal logic, conceived the possibility of this about the year 1830: "I do not know whether subsequently it will become possible to give *a priori* a genuine course of method altogther independent of the philosophical study of the sciences, but I am convinced that this cannot be done at present, the great logical processes not yet being capable of explanation with due precision, separately from their applications. I also make bold to add that, even if such an attempt could subsequently be realized, which indeed may be regarded as a possibility, this would still only be effected by the study of the regular applications of the scientific processes...."[56]

The legitimacy of logistics, in its own sphere, can no longer be seriously denied; the only thing remaining is for us to find out how far, *in reality*, it has fulfilled its task. We may repeat, however, that it cannot claim the rôle of a new method of investigation; to compare logistics with the differential and integral calculus, for instance, would be altogether erroneous. From its beginning, the differential and integral calculus has afforded a solution of mathematical problems: problems of the quadrature and the tangent, more special problems such as that of the catenary. There is nothing of this in logistics, which remains the mathematics of the elements. Nor could it be regarded as a sort of universal speciousness, wherein mathematical thought would be wholly done away with.

To sum up, there are two conceptions of logistics: the one which assigns to it a special positive function, the other which, desiring to take up in it the whole of human thought, transforms it into an algebraical scholasticism as barren as that of the Middle Ages. As

[55] Peirce maintained that logic is a branch of mathematics, M. Couturat claims that mathematics is a branch of logic (a branch far more important than the trunk from which it sprang). The question thus formally stated appears to be of no great practical or scientific interest. The main thing is that there is a branch of positive studies called logistics, that this is studied in the form of a symbolical calculation, a calculation whose efficacy is *special* since it cannot solve problems in other branches of mathematics.

[56] Auguste Comte, *Cours de philosophie positive*, 1830 edition, I, 39.

we have seen, scientific thought comes up against real problems, facts in the solution or explanation of which the reduction of the ordinary mathematical methods to the logistical methods afforded no advantage whatsoever. Logistics, *qua* universal explanation, should be condemned by the same right as any kind of metaphysics, because, being practised outside of its field of application, it remains a mere sport of the mind, of no scientific use whatsoever. Indeed it is one thing to determine and to classify the grammatico-logical elements of ordinary language, which form an element in mathematics; it is another thing to claim absolutely to reduce all mathematics to these elementary forms. In the former case you act as a scientist, in the latter as a metaphysician. The complete identification of mathematical thought with the grammatico-logical elements which condition it is an illusion analogous to that of materialistic dogmatism, which wholly assimilates thought to the elements of the brain, its material conditions of production. The proof that this identification is ineffectual results from the fact that, if logistics made the mechanism of mathematical thought absolutely transparent, and if it practically absorbed this thought, we should find no more mathematical problems offering difficulties, which logistics would not be capable of solving immediately. Now, we know that nothing of the kind takes place.

In reality, we are confronted with an ensemble or irreducible methods and data which form the various branches of mathematics. In no way could we explain all this knowledge by a systematic philosophical view. At all events, such an explanation would have no objective value scientifically. We may, however, bear witness that scientific methods are organized and transformed according to the ideal of the logician, and that, in theoretical sciences, mathematical demonstration surpasses all other forms of thought (intuition, imagination, etc.). By studying the inner mechanism of this demonstration, we glimpse the logical meaning of "the mysterious unity manifested in analytical works apparently most remote,"[67] a unity the complete realization of which could not be regarded as effectively brought about, but only as ideally conceived, at the present stage of our knowledge.

MAXIMILIEN WINTER.

PARIS, FRANCE.

[67] Hermite, *Comptes rendus de l'Académie des Sciences*, 1862, Vol. LV, p. 91.

MAN AS A MUTANT.

The failure of theology to give a comprehensive meaning to human existence was the cause of speculative philosophy. System after system, from Thales down to Bacon, attempted to explain the phenomena of nature and their relation to humanity. With the advent of the scientific era, philosophy was compelled to limit its speculations so as not to contradict the results of science and philosophy. Empiricism in philosophy became of great importance, and science became philosophic. Spencer defined philosophy as the generalization of the sciences. Science, in its turn compelled humanity to change the ideas of creation by proving that matter cannot be created or destroyed, and substituted evolution for special creation. These new ideas, coupled with the overthrow of the geocentric theory of the universe, revolutionized the whole of human thought, as shown by modern philosophy, art and literature.

Most of the philosophical systems, especially the idealistic ones, are optimistic in their nature. They all hold that nature, or its god, is conducting the universe with a special purpose in view, and that man, as the most important part of nature, has a special destiny to perform which is for his good. There are a few exceptions. Kant, although an idealist, does not show much optimism. He, like Spencer, sees constant change in nature, but unlike Spencer, he is not so sure that the change means progress. Schopenhauer developed a doctrine which may be described as a transitional form from the idealism of Kant to the prevalent realism of the present. His pessimism is derived from human experience. He emphasized with unusual lucidity the feebleness of the spontaneity of the intellect. He comes to the conclusion that not only is our world not the best, but it is the worst of all possible worlds.

The generalizations of science have a distinct bearing on the questions raised by theology and philosophy. Science in its prevaling form teaches that there can be no such thing as design in nature. Man, together with all organic life, must adapt himself to environment in order to continue his existence; and the end of all man's strivings on earth is doomed to failure. In a word, the message that science brings is woefully pessimistic. It tells us: Try as you may, make new discoveries, new inventions, dig as deep as you can in the

secrets of nature, you are one and all predestined to destruction. The following are some of the facts adduced by science in support of this gloomy foreboding.

It is well known that organic life is made possible by the energy radiated on this globe by the sun. There can be no life (except of the lowest forms) without solar energy. Science tells us that the sun's energy is diminishing continuously. Ergo, the time must arrive when the whole of the sun's energy must be exhausted. Long before that time arrives human beings will have ceased to exist. The range of temperature in which protoplasm is able to exist is very limited. The range of temperature favorable for the existence of higher forms of life is still more limited. No human being could possibly hold his own at a temperature of 60' centigrade below zero, while the absolute temperature to which the sun's energy can descend is 273' below zero. This shows that animal life on this planet must cease long before the sun is entirely extinct. The simplest experiment to show that the sun's energy is constantly diminishing is shown by an instrument known as the pyrheliometer. It is a small, hollow cylinder, presenting at one end a disk of known dimensions covered with lampblack. The body of the instrument is made of silver, well polished to prevent radiation of heat, which it absorbs through the blackened disk. The disk is turned directly to the sun. The cylinder is filled with water. All the radiant heat and light, everything in the form of radiation that falls upon the lampblack, is absorbed by it and is degraded to the form of heat energy and so communicated to the water, which contains the bulb of a thermometer, whose stem runs through the axis of the apparatus. By a simple contrivance the apparatus can be so adjusted that the blackened disk, which is always capped when not in use, will receive the sun's rays perpendicularly. The cap is removed for a measured period of time and then put on again. The instrument is shaken so that the temperature of the water remains the same throughout. The rise in temperature is shown on the thermometer. Correction is made for the loss of heat during the performance of the experiment. In this way a fairly approximate estimate of the amount of heat received from the sun in a given time can be made. By comparing the surface of the disk with the surface of the whole earth which is exposed to the sun, we can estimate how much radiant energy in the form of heat, light, actinism, and so forth, comes to us from the sun per second of time; and we can also estimate the amount of energy that leaves the whole

sun's surface every second. By many years' observation it has been conclusively shown that the average amount of energy reaching the earth is diminishing gradually. It is true that the loss is very small, on the highest estimate not more than 1° centigrade in seven thousand years, but the loss is positive; which forces the conclusion that it is only a matter of time when the earth will no longer be fit as an abode for man.

This, however, is not all. As if to make the escape doubly impossible, there is another, more general phenomenon pointing to the inevitable loss not only of life, but of all activity on earth. Our planet, in conjunction with the whole solar system, is bound to become a dead body, uniform in temperature and devoid of all motion. A thorough discussion of this idea would lead us to the subjects of Entropy and The Theory of the Potential, subjects out of place in an article of this nature, on account of the mathematical treatment that they involve. I shall, therefore, have to limit myself to a mere indication of the nature of the argument. It is based on one of the most fundamental laws of physics known as the law of the conservation of energy. The law states that energy may change its form, as mechanical into heat energy, but no energy can be a constant quantity. Experience teaches us that every change of energy from one form into another is accompanied by a loss of "available" energy. No energy was lost to be sure, but some energy has been degraded, i. e., it came down from a higher to a lower potential or level. In illustration of this principle it would be very desirable to bring in Carnot's Cycle and the subject of reversibility, were it not for the fact that it would divert us too far from the main issue. It will suffice to state that after every physical operation in the universe the whole amount of energy involved cannot be recovered in an available form. A considerable amount is lost in friction, radiation, etc. It is well known that even the most efficient steam engine converts less than one-fourth of the heat which the coal generates into useful work. The remaining three-fourths are lost, not to the universe but to man, and are thereby rendered "unavailable." As there is no process in nature which is not accompanied by a loss of "available" energy, the conclusion is forced upon us that a time must arrive when all the higher forms of energy, i. e., energy of motion, energy due to position, chemical energy, etc., will be degraded into one form of energy—radiant energy. The amount of energy will still remain constant; there will be no loss of energy, but it will all

become unavailable. Energy will reach its lowest level; after which no activity of any kind will be possible. This conclusion is a direct deduction from the second law of thermodynamics. The law is stated by Clark-Maxwell as follows: "It is impossible to transform any part of heat of a body into mechanical work except by allowing heat to pass from that body to another of a lower temperature." But as there will be no body of lower temperature in the universe it follows that all activity must cease. It is true that Clark Maxwell, the greatest mathematical physicist since Newton and Laplace, to whom all the great development in electricity, including wireless telegraphy, are due, thought that he had found a way out of the difficulty. He conceived a being whose faculties are so sharpened that he can follow every molecule in its course. Such a being, known in physics as Maxwell's Demon, could sort the molecules so as to allow the swifter ones to go into one compartment and the slower ones into another. He could then, without expenditure of work, raise the temperature of one part of the universe and lower that of the other, thus starting a difference in potential and causing new activity. I mention it here simply as an ingenious curiosity.

There is no denial of the fact that all of this is exceedingly pessimistic, and yet, as such, it must be accepted. But in all this darkness there is a gleam of light which makes it worth while for humanity not only to continue its existence but to consider its being on earth as a rare and special privilege. It is quite probable that in the whole universe man is the only being who has the privilege of a conscious existence, who is possessed of the power to analyze and synthesize objectively. It is quite probable, nay almost certain, that his conscious existence came accidentally, and that as a conscious being he is the only creature able to understand nature and study her so as to foretell phenomena centuries in advance of their appearance. All students of nature are aware of the fact that the universe is composed principally of inorganic matter. Organic life occupies an insignificant part of the time of a planet's existence. It takes untold centuries before a planet, even when favorably placed in the solar system, is able to support life. After a brief period comparatively speaking, it becomes lifeless like the moon and remains so indefinitely. A glance at our solar system will show that of all the planets that are engaged in their endless cycling around the sun only one—Mars—besides the earth may be said to be favorably placed for life formation; and if Mars possesses life, the inhabitants of Mars must

be inured to somewhat severer conditions than generally prevail on earth. The other planets are either too near the sun, where the temperature is too high, or too far, where it is too cold and dark, or they are in a gasious state so as to preclude the existence of life, especially in any high form. In this connection I will cite a paragraph of J. F. W. Herschel, one of the greatest astronomers that ever lived. Speaking about the probability of animal life on the other planets, Herschel analyzed the following three features: "First, the difference in the respective supplies of light and heat that the planets receive from the sun. Secondly, the difference in the intensity of the gravitating forces which must subsist at their surfaces, or the different ratios which on the several globes, the inertia of bodies must bear to their weights. And thirdly, the difference in the nature of the materials of which, from what we know of the mean density, we have every reason to believe they consist. The intensity of solar radiation is nearly seven times greater on Mercury than on earth and on Uranius 330 times less; the proportion between the two extremes being that of upwards of 2000 to 1. Let any one figure to himself the condition of our globe were the sun to be septupled, to say nothing of the greater ratio! or were diminished to a seventh or to a 300th of its actual power! Again, the intensity of gravity, or its efficacy in counteracting muscular power and repressing animal activity, on Jupiter, is nearly two and a half times that on earth; on Mars not more than one-half, on the moon one-sixth, and on the smaller planets not more than one-twentieth; giving a scale of which the extremes are in proportion of sixty to one. Lastly the density of Saturn hardly exceeds one-eighth of the mean density of the earth, so it must consist of material not much heavier than cork. These physical peculiarities show how improbable it is for higher forms of life to exist on the other planets of our solar system. It may, however, be argued that there are many more systems scattered through infinite space where the planets are as favorably placed to their illuminaries as the earth is to our sun. Granting the universal law of evolution, we must admit that those planets must also reach a state when their physical conditions are favorable for the support of life. Hence they too must go through the same cycle of evolution as our earth, reaching as high a state of mental development and even higher. In fact this is now the accepted belief of most scientists Proctor, reasoning on these premises, comes to the conclusion that in any given time it is safe to assume that no other life exists on

other planets than the earth. He bases his conclusion on the fact of the insignificant duration of life on any planet as compared to its lifeless existence. Given any planet, the probabilities are that either it has not as yet reached the state of development capable to sustain life—as Jupiter or Saturn—or the life sustaining period is all over, as in the moon. This is sound reasoning. It is based on the law of the Uniformity of Nature and on the Theory of Probability. This tacitly assumes the existence of life, in all its forms, on every planet during a certain period of its development.

Reasoning, however, from different data, that came to light since Proctor's essay was written, it seems to me that there are strong grounds that preclude such an assumption. According to Darwin, the animal kingdom has developed very slowly from the lowest organism into the highest forms of life. The time required for such development was recognized by Darwin himself to be very enormous. This great length of time would not matter in an ocean of infinity, had there been no objection from other quarters. Both astronomy and geology in calculating from their respective data the probable age of the earth, fall short of the time necessary for the development of the different species on a planet ripe to support life. It is also interesting to note that, although starting from different considerations, the conclusions reached by both astronomy and geology as to the probable age of the earth is almost the same. There is good reason to believe that Darwin forsaw this difficutly but could not account for it. Lately, however, new light was thrown on this subject by the investigations of Hugo De Vries. In his "Experiments and Observations on the Origin of Species," De Vries propounds what is known as the mutation theory. According to this theory life has not developed gradually and slowly but it came in leaps and bounds. Occasionally some new species appears, sometimes not at all resembling the parents and very often of a much finer and higher type. This new species continues to propagate its own type without ever returning to the lower characteristics of the ancestors. By accepting this theory (and it is now universally accepted by biologists) the time for the development of life on earth is very much reduced, so as to fit in with the calculations of the astronomers and geologists. That man is a descendant of the simian family is accepted by almost all biologists. New evidence has lately been added from quite different sources which show conclusively the relationship of the human species to the anthropoid apes. From

a morphological standpoint it is admitted that there is a missing link between the highest ape and man. If this is true from the morphological standpoint, it seems to me that from a psychological viewpoint not one but a thousand links are missing between the higher animals and man. I am perfectly aware that animals possess some intelligence, and even foresight, but they do not possess to any considerable degree the objectivity, the contemplation, the conscious thought, in a word, personality, that are peculiar to the human. Not only do they not possess these qualities, but there is no evidence of their ever being able to acquire them. Huxley made the statement that his dog was more intelligent than the Australian Bushman because the dog could count up to four while the Bushman could not count more than two. If a group of more than two be presented to him he calls it "many," no matter how many units it contains. But we must take into consideration the potentialities of the Bushman. As far as I know nobody has ever succeeded in teaching a dog reading or writing, nor an anthropoid ape arithmetic or algebra. Most people would agree that such a task would prove impossible. On the other hand, there are good reasons to believe that the Bushman, through many generations of training and education, could be brought up to a high degree of culture. Circumstances have kept him in a savage state; but apparently he possesses the potentialities of the civilized human. He possesses a remarkable faculty for graphic illustration. The Bushmen show some skill in their drawings of men, women, children and animals. They are valued as servants by the Boers for their possession of sufficient intelligence to perform their work properly.

This almost infinite gap in intelligence between higher animals and man can only be explained by the mutation theory. In analyzing the physical features of anthropoid apes and man Metchnikoff infers "that man is a case of the arrested development of some simian of ancient days, as it were, a simian monster from the zoological point of view, altho not from the esthetic. Man may be regarded as a prodigy sprung from an ape, born with a larger brain and an intelligence more highly developed than occured in his parents." His appearance on earth, then, was sudden, as an accident. As such an accident he is the sole exception to all life on the globe. He is the only self-conscious animal, planning for his future, prophesying events in nature a hundred years to come, able to analyze the composition of worlds almost an infinite distance away, trying constantly

ARISTOTLE AND THE CRITERION OF TRUTH.

In these days of subjectivist theories of truth, when every philosopher's attitude on truth is canvassed, it is interesting to recall the attitude of Aristotle. He, too, has been assigned to the subjectivist position, with what correctness we shall see. Not that Aristotle dealt with the question of the criterion of truth as we now discuss it, but that noetic problems had to be implicitly considered by him as by every systematic pre-Kantian thinker, and that we may gather, from his teachings in various places, what were his views on truth and certainty in general. These last may not always be so explicit as might be wished, but they may be sufficient to show that his criterion of the truth was objective evidence. Aristotle held that reality had a permanent or essential nature, and that this can be grasped by thought. On the accord of our judgment with the objective order of things, the truth of our knowledge in his view, depends. He takes an objective view when he tells us (*Met.* VIII c. 10)[1] that that which is, in the strictest sense, entity, is what is true or false, and that, in the case of things, this consists in composition or division. This latter insistence he repeats in the *De. Int.* c. 1. He maintains that the alternative, true or false, constantly presupposes a combination or συμπλοκή, for of words spoken without connection, none is either true or false (*Cat.* c. 8.)

But there are more important things for our purpose to be said. Aristotle tells us there are first truths which carry our assent (πίστιν), not by means of other truths, but of themselves. It is not necessary, he continues, in the case of the principles of knowledge, to ask that by which, but each of the principles has the proof (πιστήν) of being in itself (*Top.* I. c. 1).

Aristotle seems plainly to point to the principle of certainty as something objective, the first truths being regarded as determining our assent. The concern of Aristotle with the *isness* of these first truths or principles is primarily essential, rather than evidential. It is strange that Sir Wm. Hamilton should have taken this passage as ground of his affirmation that "Aristotle founds knowledge on belief, and the objective certainty of science on the subjective necessity of believing." The error appears to have arisen from the oc-

[1] Sometimes called Book IX.

currence of the word πίστις, which seems clearly not meant in the frequent sense of faith or belief, but, as in occasional usage, in the sense of a reason or proof, a means of persuasion or assent. There is a similar use of πίστις by Plato for proof or argument, in *Phaedo* (70 B), but I leave out of account the usage of Greek theological writers.

It is a great injustice to Aristotle when Hamilton erroneously says "he founds knowledge on belief," since knowledge never rests on mere belief, however belief may accompany or even outrun it. Aristotle founded knowledge on fact as known in perception, and on principles grounded in reason. Not on some vague thing called "belief" did Aristotle found knowledge, but on first principles which could not be denied, which necessarily conditioned all other knowledge, and which did not presuppose other principles higher than themselves. He based knowledge, further, on dialectical induction, and logical demonstration, as he plainly intimates (*Anal. Post.* II. c. 25). He presupposed experience (*Anal. Post.* I. c. 14; *Met.* I. c. 1), and reached out after knowledge proper—knowledge that was to him scientific—in the comprehension of the universal by means of thought. Such scientific knowledge meant objective cognitions, that is to say, it was of the object *qua* object.

In another instance, Hamilton takes πίστις in the sense of faith or credence, where again it seems clearly to signify proof or argument. That is where, when speaking of the diverse opinions as to rest and motion, Aristotle says that "against all these one proof (πίστις) is sufficient, for we see that some things are now in motion, and now at rest" (*Phys. Aus.* VIII. c. 3). It seems beyond doubt that evidence, and not anything subjective, was the principle of certainty to Aristotle. He connects the truth of our concepts with the reality of the object, not with the satisfaction of our nature. Evidence is primarily concerned with the object, and its intelligibility. We may say that Aristotle's objectivism was that of his time, but objectivism it was. Besides, the expression "we see" in the passage might have suggested to Hamilton that πίστις was not being used in the subjective sense which he supposed, since faith is opposed to sight.

Again, Aristotle says the understanding seeks the truth by judging of a thing conformably to its own essence(*De. An.* III. c. 6.)

This again seems an invocation of objective evidence in the search after knowledge of the truth, even though we are here in a

more abstractive region, where some may prefer to take a more purely abstract or intellectual view of the universal. The thing cannot exist apart from its essence. The essence was still the essence of the particular, in which last the universal was immanent, for Aristotle will not have essence and phenomenon torn apart. For the essence, though ground of the particular phenomenon, is not purely an *ens rationis* for Aristotle, since it is real and actual only in the particular phenomena themselves. Even Rosmini insisted that essences are "objects" and "truly exist, at least as objects of the mind." Whether Aristotle's positions, I may add, as to knowledge being of the individual and knowledge being of the general, are so impossible to reconcile as Zeller and Benn suppose, is, I think, open to question.

An important passage for our present inquiry is that in which Aristotle, speaking of the principle of contradiction, says that the most certain principle of all is that concerning which there is no possibility of deception, for such must needs be that which is most known of all (*Met.* III. c. 3; X. c. 5). In this connection *Anal. Post.* II. c. 15, should also be considered, where in certain passages the denial of such principles as that of contradiction is taken to make knowledge impossible. But if the principle which is most known is to be taken as that which is most certain, it would seem that, by Aristotle, the certainty of this principle—that you cannot affirm and deny being at the same time—was, in its self-evidence, taken as criterion of the truth. The possibility of certainty underlay his whole doctrine, however little he may have engaged himself with certainty as a problem. But it is objective certainty he is concerned with, that of the truth in itself of the object or principle, not anything of the purely "subjective" character spoken of by Hamilton. For it is in the thought-truth itself—not in our subjective thinking—that objective evidence is in the first instance grounded; that is just what renders it criterion of the truth and principle of certainty. There is an evidence of the thing which is nothing but the truth itself evident, and it is of that I am speaking; but there is also an evidence, which is in us, and consists of our knowledge of evident truth. Every true thing is evident; but a thing is not evident for us by its simple truth, but because our intelligence can reach the truth. And the truth itself Aristotle did not confound with our criterion of the truth. Certainty neither denotes knowledge, nor is the equivalent of knowledge, where mere subjective

certainty is concerned. But knowledge does include certainty. Truth, however, is not yet certitude. Certitude is the relation of truth to knowledge, and certitude rests on subjective and objective factors. Knowledge is not simple certainty, but certainty based on cognition. Certainty involves persuasion of the truth, but not the truth itself. A position is objectively evident when the understanding judges that it is necessarily so, and cannot be otherwise. It is one to which we cannot refuse assent, unless we disavow our reason. It is in the spirit of Aristotle that Aquinas, in his work on the Sentences, says "—Certitudo, quae est in Scientia et intellectu, est ex ipsa evidentia eorum quae certa esse dicuntur."

For Aristotle, all ultimate grounds of knowledge were intrinsic, necessary, self-evident. It is of interest to note, in respect of the passage in *Met.* III. c. 3, that that skilled interpreter, Alexander of Aphrodisias, says that, for Aristotle, the principle of contradiction was "known by itself, evident, and indubitable." The self-evident certainty of the first principles or *Grundsätze* was a prime concern of Aristotle, for on them he held all science to depend. "It is necessary," he says, "that the first principles of things, always existing, be always most true" (*Met.* I. c. 1; *Nic. Eth.* VI. c. 7, 2-3).

But their truth must be manifest to our reason; this means their evidence, so far as we are concerned. Aristotle objected to the theory of Heraclitus that, in "affirming all things to be and not to be," it "appeared to make all things true" (*Met.* III. c. 7.) And he maintained the need, in all learning and instruction, of antecedent principle or conviction (*Anal. Post.* I. c. 1.) Also that in the *reductio ad absurdum* mode of demonstration, it is assumed that everything must be either affirmed or denied (*Anal. Post.* I. c. 11.) To him, the principle of demonstrative reasoning may, in itself and in its nature, be the better known, but the inductive mode may be the better known to us (*Anal. Prior.* II. c. 25). It is what is known in itself that I am here concerned with. Things, in Aristotle's view, imposed themselves on thought, and knowledge sprang from the agreement between them. Thought and its object were to him one (*Met.* XI. c. 7; *De An.* III. c. 4.) But this does not mean that reason is overborne in the process, for he tells us that reason is such as to be apprehensive and creative of all things (*De An.* III. c. 5). And, objectively, "all order is reason" (*Phys. Aus.* VIII. c. 1). But he admits that the difficulty of reaching truth "may not be so much in things themselves as in us" (*Met.* I. c. 1).

Another passage may in this connection be referred to. Aristotle says that "not every problem, not every thesis, need be examined" (*Top.* I. c. 9.); for, he goes on to say, there are things that are beyond doubt, such as honor of the gods and love of ancestors. The ingenious mind of Alexander of Aphrodisias was not slow to put forward that in this passage Aristotle was finding the principle of certainty to consist in the evidence. It is at least in keeping with what Aristotle elsewhere urged as to the nature of self-evident truths, whatever may be thought of the examples chosen. But Aristotle thinks those who doubt in the cases mentioned deserve castigation, while those who doubt that "snow is white" merely show false sense or wrong perception.

Confirmatory of what has already been advanced is the fact that Sextus Empiricus plainly intimates (*Adv. Math.*) that two criteria of truth were held both by Aristotle and by Theophrastus, viz., perception for sensibles, and intelligence for intelligibles, and that Theophrastus, more explicitly, put forward evidence as the criterion common to both cases. But Sextus also says that the Stoics recognized two criteria of truth, viz., the sensible and the intelligible, the former true only relatively to the latter. But though the Stoics imitated Aristotle, they were less able to handle the problem. They saw the need for certainty, but without discovering the mode of its attainment. They tended too much to make the distinct sensuous impression the criterion of truth. And yet, like Aristotle, they tried to found science on reasoning, and went beyond him in the lessened place they accorded the universal. But Stoic thought vacillated on the criterion to its own disadvantage. But "the criterion of the Sceptical School," says Sextus, "is the phenomenon, and, in calling it so, we mean the idea of it." He says, further, that we consequently live by giving heed to phenomena, observing these in daily life in an unprejudiced manner (*Hyp.* I. c. 11.) Aristotle, no doubt, held the truth of sense-perception, but simple perception does not suffice to give certitude; there must be a judgment, and a judgment is not contained in the perception as such; only the light of reason renders us certain of what sense attests. Aristotle himself taught that truth belongs only to judgments which represent the way in which real things are conjoined or divided. He who so thinks has the truth, in his view. But for the sensible phenomenon he only claims a certain truth for him to whom it appears, but not truth absolutely. Sensuous perception

does not give us certain knowledge—knowledge of the particular only, not of the general (*Anal. Post.* I. c. 31). It is for him ground of the higher knowledge of principles, through the intellect or understanding.

I have not been concerned either to justify or to criticise Aristotle's positions as to the criterion of truth, but merely to state or elucidate them, mainly from his own works. I think Aristotle held, though not perhaps in so many words, that the criterion of truth does, in fact, exist, and is found in that objective evidence which determines our assent, and engenders in us certainty of the truth. For him, the evident was true, self-manifesting in variant forms in the realm of primordial fact. Such, I think, was to him the objectivity of truth—truth grounded in the nature of things, and prior to all formal truths or judgments.

JAMES LINDSAY.

IRVINE, SCOTLAND.

PHILOSOPHIC POSSIBILITIES IN SPACE.

It has been suggested, supposed and even emphatically stated that the universe is finite. The most recent statement concerning the limited nature of the universe was made by Professor Einstein, the modern mathematical wizard. Einstein has traveled in thought through the abysses of space where he discovered new and startling laws and theories of light and gravitation.

It somehow seems contradictory that a mind which is so wonderfully capable of detaching itself from that which is local nevertheless conceives the universe to be a finite something. Yet there are many such minds. One reads occasionally about an astronomer who expresses the hope that some day a giant telescope may reveal the limits of the universe to the eager gaze of man.

Of course, we do not always make ourselves clear as to the definition of the word, universe, which we have in mind. Did Pascal refer to the immensity which consists of matter *and* space when he observed that the universe is an infinite sphere the center of which is everywhere and the circumference nowhere? Does Einstein consider solely the world of suns, planets, stars and comets when he

states that the universe is finite? Does he leave space entirely out of his calculations?

If Einstein does ignore the existence of space, he presents us with the following extra-ordinary spectacle: a cluster of stars and a milky way that whirl in unutterable solitude in an infinite vastness of space. This mass of sun-systems is as a pin-head lost in a boundless immensity. The question arises: Why should the Creating Hand solidify a few suns and planets into this single pin-head when there is room for an infinite number of such pin-heads? What *is* our physical universe, a single grain of sand suspended in a shoreless ocean?

If Einstein includes space in his calculations, then one cannot but marvel at the absence of logic in a mind which is otherwise so keenly logical. We are, in that case, required to imagine a universe of space and matter which at certain points comes to an abrupt end. Now, we may fool ourselves into believing that we can imagine such a universe. But that same imagination will insist on peeking beyond the boundaries which it, itself, has imposed upon the universe. It will stubbornly inquire whether or not something exists beyond. The inevitable answer to such inquiries is that space, at the very least, is to be found on the other side of the little fence, or wall, or hedge, which our imagination has built around the universe. Of course, we can continue forever to build that imaginary little fence, or wall, or hedge. But we will also continue forever to find at least more space beyond it. In other words, space is infinite.

Now, I am well aware that this last statement is open to criticism. It may be argued that space is not absolutely infinite; that it lacks the existence of the so-called Stellar universe from being an absolutely infinite existence. Space (in this magazine) does not permit me here to show that the statement in question is ultimately correct, and as I intend, further on, to hint at the unity of our apparently heterogeneous universe, I will satisfy the critical mind at present with the following modified statement: The universe of matter and space is infinite. Or, to put it differently: existence in its totality is infinite.

Here, we have, I believe, a truth which will serve as a foundation, beyond comparison solid, for the little structures of Truth which we every once in a while attempt to build. In the first place, it is a self-evident truth; as self-evident as the truth that the shortest line between two points is the straight line. In the second place, it con-

cerns the nature of the whole of existence instead of that of an infinitesimal part of the whole. And when we have obtained an idea of the nature of the whole, the nature of the part and that of the relationship between the part and the whole cannot forever remain an unfathomable mystery.

We have erred in the past either by assuming that the universe is finite or else by ignoring its infinite nature. The intellect will not reach its ultimate aim of understanding solely through concentrating on the study of the part or of a group of parts. It should be guided by the realization that a whole exists, and that the nature of that whole is naturally and inevitably infinite. Such a realization comes easily to him who is able to live in thought beyond the limits of his immediate surroundings and personal interests, beyond the limits of earth and sun-system in the center of a universal vastness. For it is the endlessness of this vastness which will suggest to him the possibility of ultimately solving some of the deeply hidden mysteries of existence in its depths.

To return to the presence of space, which led us to the conclusion that existence in its totality is infinite: a curious fact concerning it is, that the mind *cannot think it away*. Imagination is capable of scattering the beauties of the flower, of destroying the sun, of obliterating the starry hordes. But the most elastic imagination is absolutely incapable of destroying the existence of boundless space. It takes away that illimitable vastness merely to find that another infinite vastness has taken its place. Space is indestructible.

Now, instead of endeavoring to imagine its destruction, let us try to imagine its creation. The mind meets with the same peculiar difficulty. It is absolutely incapable of conceiving a condition of no-space. Space is uncreated. Apparently then space is eternal in its existence. The self-evidence of this truth rather forces itself upon our minds, provided of course that we think about space at all. And it seems to have forced itself upon the minds of the ancients who took its presence, or rather, omnipresence, for granted. The Babylonians, for instance, caused Apsu and Tiamat to create an army of monster-gods who peopled the "waters of the deep." But they did not so much as hint at the origin of the "deep." The deep was conveniently there. And in Genesis, Jahveh created the heaven and the earth, and darkness was on the face of the deep. Again the deep existed before the dawn of creation.

We have come face to face with eternity on another occasion, *viz.*, in our laboratory. It was discovered there that matter is indestructible, and that its amount in the universe is for ever the same. Of course, when we accept the story of creation we are forced to conclude that the universe of matter was destined to exist eternally after a certain moment. Prior to that moment it did not exist. This is palpably absurd. It is just as ridiculous to conceive of infinite duration with a beginning as it is to conceive of infinite space with a starting point. That which will exist eternally in the future has existed eternally in the past. It is a strange immortality that needs to be born!

When we state therefore that matter is indestructible, we clothe in different words the sublime fact that the universe of matter in its totality is absolutely eternal. The whole never changes, the parts do. Now, it will be agreed that the existence of two eternities is a logical impossibility. It follows then that the eternity of matter is identical with that discovered in space. A single eternity pervades matter and space alike. And when two seemingly separate existences are both eternal, they are fundamentally one and the same existence. Our apparently heterogeneous universe of matter and space is a unit—a single existence of a uniform fundamental nature.

This last conclusion follows immediately from the fact that something exists which is infinite in its totality. We have seen that the totality of existence is boundless. This being so, there can be no question of several separate and independent existences composing the universe. The single thing which is infinite as a whole is the only thing that can possibly exist. Its presence excludes the possibility of the existence of one or more things beyond the infinity of that presence. Space and the stellar universe are solidly linked by the bond of an ultimately identical fundamental substance.

Pascal's brilliant definition of the universe may therefore be modified as follows: The universe, an infinite—eternal sphere of substance, the center of which is everywhere and the circumference nowhere. I shall not here attempt to discuss the possible nature of this fundamental "substance." It is merely my aim in this article to show that a little thought on space may reveal the fact that enormous possibilities of truth lie concealed in its depths. Nor do such truths differ greatly from the truths concerning existence which we hitherto have accepted on faith by failing to derive them from fact and reality.

Let me suggest that infinity, omnipresence and eternity are to be definitely located in the universe. They *are* existence in its totality. In the light of cosmic philosophy such attributes emerge from the abstract into the real. In the past we have paid too much attention to ourself, to its future existence in a hereafter, and to the Power that determines the nature of that future existence. We possessed a deity principally because we were in need of one. We erected his throne anywhere beyond the supposed limits of this mortal world, and endowed him with the attributes of infinity and eternity. But these attributes were meaningless to us, even as our Supreme Power, though we intuitively realized the necessity of his existence, could be associated with reality only with the utmost difficulty.

All this is due to the fact that evolution had not as yet coaxed man from his shell of self-centeredness. On the whole, man lives in a little universe of his own making; a little universe bounded by the limits of self-interest. What lies beyond these limits, lies also beyond the limits of his intellectual powers. How many of us, to-day, look at the stars without seeing them? How often do we not babble learnedly about the infinite and the eternal without suspecting in the least that we daily face these realities; without suspecting that we live, move and have our being *in* them?

However, evolution constantly urges man to live in an ever-broadening universe. Contact with life wears off some of the hardness of that shell of self-centeredness. Experience, and principally that experience which is the product of struggle, adds little by little to the size of the world in which he lives. History teaches nothing but just that. It records man's struggles with nature, and subsequently with organized society. It records the gradual development of the mind and a corresponding growth of the universe which the mind is contemplating. Less thought of self, and more thought of the balance of existence; less selfishness and more altruism; less ignorance and more understanding—here we have in a nut shell the mysterious aims of human evolution.

That man's mind is broadening by leaps and bounds, and that it is beginning to seek divinity in the infinite reality which constitutes his universal home becomes more and more apparent. Perhaps we should go back as far as Columbus and his discovery of the New World to find the birth of the universal mind. Man became compelled to think in terms of continents instead of in terms of shacks and palaces, in terms of earths instead of in terms of private estates

Steamships, railroads, telegraph and telephone, wireless, flying machine—are they not the creations of a mind that has learned to fly away from home, from ME, and do they not in turn teach the average man to think thoughts that are broad and universal rather than narrow and local?

Copernicus, Galileo, Newton, and their illustrious followers paved the way for the cosmic mind, drew the attention of man to the existence of a stupendously large universe, which he could not very well exclude from his philosophic calculations. The ultimate outcome will be, that divinity will be sought in the one reality beyond which nothing exists, *viz.*, existence in its infinite totality. This statement may at present sound to many ridiculous, if not unreligious. This may be due to the fact that we are not accustomed to live in thought in an infinite universe. Also, we are on the whole rather well satisfied with the deity which the ancients so conveniently conceived for us. But, a little reason will convince us that many objections from a religious point of view might be eliminated. Let us forget, for the moment, the appearance of the universe. Let us forget that such a base, miserable thing as matter is to be found in it. Let us further consider that this infinite is inseparably associated with eternity . . . But, enough! Let the reader think for himself, and decide for himself.

In concluding, it should be remarked that the infinite presents us with a number of truths that are helpful in bridging the wide chasm which seems to separate the part from the whole, the finite from the infinite. Starting from the proposition that existence in its totality is infinite, the following truths suggest themselves:

1. That which is infinite is also eternal.

1*a*. An infinite whole is eternally unchangeable (as a whole).

2. There can exist but one infinite and therefore but one eternity.

3. Given an infinite existence, no other separate and independent existence is possible.

4. An infinite existence is an infinite unit.

5. All individual existence is fundamentally part of the infinite existence.

6. An infinite whole consists of an infinite number of constituent parts.

7. That which is infinite is eternally unchangeable as a whole, but its parts are necessarily subject to constant change.

H. R. VANDERBYL.

VOL. XXXI OCTOBER, 1921 No. 4

THE MONIST

RELATIVITY AND ITS PHILOSOPHIC IMPLICATIONS.*

Aeltestes bewahrt mit Treue,
Freundlich aufgefasstes Neue.
—Goethe.

OF all the natural sciences physiology would seem to touch the common interests of mankind most broadly and closely. As it becomes more and more rigorously scientific, it tends to resolve itself into chemistry. Witness the recent experiments of Loeb and Northrop on the aseptic flies of Bogolanow and Guyénot, indicating that the natural duration of an organism's life is the time necessary to complete a chemical reaction or a series of such reactions, and that it is doubled or trebled by lowering the temperature 10° C. Similarly, as chemistry becomes more strictly scientific, it tends to resolve into physics, and physics tends likewise to pass over into mechanics, which, we all know, lapses into mathematics. Mechanics has been defined by Kirchhoff, with startling clearness and exactness, thus: "Mechanics is the science of motion. Its problem is to describe the motions that take place in nature, to describe them completely and in the simplest way." A description is complete when it answers every rational question that can be put, but to say when it is simplest is not so easy. The simplest description possible to-day may not be the simplest possible to-morrow. Anyway, the final problem of all the physical sciences is thus seen to be *the description of the motions of the physical universe.*

*Address delivered at the New Orleans meeting of the Southern Society of Psychology and Philosophy, April, 1920.

Motion is change of place, or position in space, during time. To describe it is to tell how position changes as time goes on. Any point or position in our space is determined and distinguished from every other by three mutually independent measures expressed by numbers. Thus, if you know how far, that is how *many* feet, the point of this pencil is from the end-wall, from the side wall, and from the floor, then you know precisely where it is and where no other point is. Similarly, to know where a star is, you must know just three such things: as, its angular distances from due east and from the horizon—these two will enable you to point at it—and lastly, its distance in the direction thus determined. Three such things you *must know,* and anything else independent of these three you *cannot* know, about a position in our space. Since *three* such measurements are necessary and enough to fix any point in our space, we say that space is *three-dimensional.* Any three such measurements for a point are called its *coördinates.* We are all familiar with such, as latitude and longitude, which *two* fix a position on the earth-surface, which surface is accordingly called *two*-dimensional. We use such coördinates in addressing a letter, as 74 Ninth Street. Here 74 and 9 are the two coördinates fixing the place on the surface. If further we specify tenth floor, the 10 is the third coördinate, fixing the position in three-dimensional space.

All sorts of coördinates are possible and in actual use. The simplest are the so-called rectangular Cartesian (from their inventor, Descartes), the first already mentioned, as the three distances of a point from three walls or planes concurrent in a point called the origin, the starting-point, and denoted by the letter O. These three coördinate lengths are conveniently measured on the three edges of the room, meeting in the origin O; these edges are straight, lines at right angles, each to the other two, and are called the rectangular axes of X, Y, Z; the three lengths or co-

ördinates are also denoted by ex, y, z; thus, the pencil-point, e. g., may be the point (5, 9, 12). Every such set of three values represents a point, and conversely, every point represents a set of three such values.

Each of us carries a set of such axes in his own body; the up-and-down axis, the right-and-left axis—formed by the out-stretched arms, and the fore-and-aft axis (a horizontal line, which we may imagine passing directly through the breast and back, midway of the shoulders). We tell where a point is by telling how high or low it is, how far to the right—or left, how far to the front or behind, up, right and front being marked +, down, left, and behind marked —. As we move hither and thither, we change the position of these axes, and this change expressed in mathematical terms is called *transformation of coördinates.* Any point whatever may serve as Origin O, and in space there is a threefold infinity of such possible origins; every hither-thither motion is a change of origin. A man may also wheel round, remaining upright; here the origin remains fixed, but the two horizontal axes are rotated round the third or vertical axis. Similarly he may rotate on a horizontal bar round the right-and-left axis, or even by a special mechanical contrivance round the fore-and-aft axis, and in each case through any angle whatever. Here again there is then a threefold infinity of possible changes of axes, making in all a six-fold infinity of possible transformations of coördinates. Any single transformation involving both any change of origin and any rotation of axis may be expressed by a set of three simple equations. The totality of all such possible transformation is called a *Group,* that is an aggregate of operations, such that the product of any two is itself some third member of the Group.

The stress here laid upon these notions has been intentional though reluctant; for they cannot be stressed too

heavily. Indeed, the very heart and soul of the New Mechanics is this same *Transformation of Coördinates.*

Passing now to our subject-matter proper, we note that all men are familiar with the fact that motion is in some sense relative. You sit motionless in the car while it speeds along the track. You move with it but not in it; you are at rest relatively to the car but in motion relatively to the track and all outside space. A child knows all this but does not estimate the facts at their full significance. To bring them out clearly, let us imagine a number of coëxistent compunctual spaces. This need not bewilder anyone. You may take any rule and slip its edge along another rule-edge or any straight line. Here one straight line coincides with and slides along another. Now consider a surface. Suppose you pull on a perfect-fitting glove. Here the inside surface fits and moves on the surface of your hand; the two surfaces coincide point for point, and one moves on the other. Still better, since these surfaces are not isotropic, suppose a perfect sphere covered with a delicate film or gauze; then we may imagine this later slipping round over the sphere surface every way, the two always coincident point for point. Quite similarly we may imagine one isotropic space coinciding with another point for point and yet moving anyway in that other, always maintaining exact coincidence. So, too, we may imagine a third space moving in the second, a fourth in the third, and so on. We may imagine each of these spaces with its own proper color, red or green, blue or yellow, and all coexistent like all the colors in the white sunbeam. Or we may imagine a single point, when it moves, as staining each space with its track of a different color in each, red in one, green in another, and so on; and this seems to be very important.

Now imagine a man on a ship sailing west on the Equator 20^{m} an hour. He looks over the ship's side and drops a penny into the deep. It falls down straight, as he

sees it—that is, it makes (say) a straight red track in the man's space, Sm. But not in the ocean space, So. To a man out there at rest on an island the penny falls to the sea on a green path, a parabola. Or consider simply the man. In his own ship-space, Sm, he is at rest. But in the Equator space, Sq, he is moving on a green path parallel to the Equator 20^m an hour west. Meantime, this Equator space is itself whirling eastward round the earth's axis in an axial space, Sx, at 1000^m an hour. In this Sx, then, the man is making a circular blue streak 980 miles an hour. Meantime this axis is being swept always parallel to itself round the sun on an immense ellipse at 18.6 miles per second. In this sun-space, Ss, then the man is tracing an enormous yellow spiral, one spire per day, moving round it 980 miles an hour and forward on it 18.6 miles a second. Meantime, the sun itself with its space is moving through universal space, Su, at a great rate, and in this Su the man is tracing out a purple path of almost indescribable complexity. Each and every one of these paths is just as actual as any other, each is relative to a higher space supposed at rest relative to the other space moving in it.

The question now arises, when does this stop? Where shall we find a space that is at rest absolutely, that is not swept along in some still higher space, so that with respect to this space any path will be the true path and any motion the true motion? You see at once that this sounds a little like asking for the true beginning of time and of the world. However, Newton and his successors believed firmly in an absolute space and an absolute time, though admitting of course the relativity of all observations so far. But could such an absolute space be actually found? The supposed answer was, Yes! For was not such an absolute actually present in the (assumed) universal aether which was (supposed to be) absolutely at rest? It was indeed the long and strenuous contention of George Gabriel Stokes that the

ether was carried along by the planets in motion, much as the air is carried in a closed car; but profound researches especially of Lorentz, the great continuator of Maxwell, showed that this could not be, that electro-magnetic-optical measurements required that the aether be stationary, so that a body rushing through it would be like a man running through the still air—there would be a hurricane "Aether-wind" in the opposite direction. There then in the ether was supposed to be found the great unmoved immovable, to which all motions were to be finally referred.

A very natural question was, "How are we, how is the earth moving in this 'stagnant' ether?" In a letter directed to David Todd by Maxwell, March 19, 1879, shortly before his lamented death (November 5, 1879), and published in *Nature* shortly after (January 29, 1880), a method of astronomical attack upon the problem was indicated, and it was remarked that the time of passage of light forth and back between two points A and B would be longer if the points were in motion than if they were at rest; but inasmuch as the difference would depend on the reciprocal of the squared velocity of light, Maxwell thought it would be "quite too small" for possible observation. In this latter judgment he was at fault. In 1881 Albert Abraham Michelson, a young German, since become the especial boast of American science, performed at the Astrophysical Observatory at Potsdam a modification of Fizeau's famous experiment, by which the motion of the earth in the stagnant ether should have been distinctly revealed in the displacement of certain so-called interference fringes of yellow light. The ingenious experiment consisted in superposing two beams of light that had made equal trips forth and back from two mirrors, one of the trips in the direction of the earth's flight in its orbit, the other at right angles thereto. It was like comparing the time of swimming directly across a stream with that of swimming the same distance directly

against, and then directly back with, the current. To the great surprise of the whole tribe of physicists, the experiment, though executed most successfully and with exceeding care, did not show any motion of the earth relatively to the ether. Some doubt, however, remained, for Michelson had supposed that the time of the light's transverse passage would be "entirely unaffected" by the earth's orbital motion; on the contrary, it would be lengthened by almost exactly half as much as would the time of passage along the earth's orbit. In fact if l be the length from the source, S, to the first mirror, M, v the velocity of the earth, c the velocity of light in vacuo (always and everywhere the same), T the time of passage to the mirror, T_1, the time of reflection back to S, then in the forward flash the light overtakes the mirror, with the effective speed of $c-v$, hence $T=\frac{l}{c-v}$; but in reflection the light meets the mirror, with the effective speed of $c+v$, hence the time $T_1=\frac{l}{c+v}$; the sum of the two is the whole time or $T+T_1=\frac{l}{c-v}+\frac{l}{c+v}=\frac{2\,l\,c}{c^2-v^2}$, and the total distance covered is $\frac{2\,l\,c^2}{c^2-v^2}$ or $\frac{2\,l}{1-\frac{v^2}{c^2}}$. In the transverse passage the distance each way, forth and back, is the hypotenuse of a right triangle, its length is $l/\sqrt{1-\frac{v^2}{c^2}}$ and the total time $2\,T^1$ is not $\frac{2\,l}{c}$ (as if the earth were at rest) but

$$\frac{2\,l}{c}\Big/\sqrt{1-\frac{v^2}{c^2}}=\frac{2\,l}{c}\left\{1+\frac{1}{2}\cdot\frac{v^2}{c^2}+\frac{3}{8}\cdot\frac{v^4}{c^4}+\cdots\cdots\cdots\cdots\cdots\right\}$$

whereas $T+T_1=\frac{2\,l}{c}\cdot\frac{1}{1-\frac{v^2}{c^2}}=\frac{2\,l}{c}\left\{1+\frac{v^2}{c^2}+\frac{v^4}{c^4}+\cdots\cdots\cdots\right\}$

In this case the earth-speed v is only $\frac{1}{10{,}000}$ of the light-speed C, hence $\frac{v^2}{c^2}=10^{-8}$, and $\frac{v^4}{c^4}=-10^{-16}$.

This latter is far too small for any observation, hence it is neglected, and the difference of the two times is almost exactly $\frac{1}{c}\frac{v^2}{c^2}$ (just half of Michelson's first reckoning). After Lorentz had called attention to this oversight in a penetrating memoir (1886), Michelson along with Ed. W. Morley repeated the experiment in 1887 with far higher degree of accuracy but with the same negative result, and the latter again in 1905 with D. B. Miller with still greater care and precision, and still with the same result. In 1904 Trouton and Noble tested the matter electrically, by swinging up a very delicate parallel-plate condenser, the plates in a vertical plane free to rotate about a vertical axis. If the earth had any velocity relative to ether, a measurable swing should be set up in the condenser by reversing its charge regularly twice in the natural period of swing, just as one may set a pendulum to swinging by pushing it ever so lightly, this way and that, at each instant of its swing through its mid-position. Again it was the unexpected that happened: the condenser would not swing, thereby indicating there was no detectable motion of the earth relatively to the ether.

These and other indications pointing the same way are now accepted as conclusive. So far as we can observe the earth is absolutely at rest in ether; in spite of its spin round its axis, its orbital dance round the sun, its age-long flight among the stars, it does not move relatively to ether.

Of course, thinkers came forward with suggestions to explain this confounding fact. First, it seems, the British Fitzgerald advanced an idea, which met the fate of so many British thoughts, and was past unheeded until presented afterwards independently by Lorentz of Amsterdam—namely, that of the two supposedly equal arms of Michelson's apparatus, the one lying orbitally was shortened by the velocity of the earth's motion; in fact, that every body

shrinks in the line of its motion in the fraction $\sqrt{1-\frac{v^2}{c^2}}$, but not transversely, at all. This would account exactly for the absence of the expected displacement; but such a shortening could not be detected by measuring the two arms, for if laid down side by side they would be found equal, since each would shrink in the same ratio. In fact, no changes in size that affect the measure and the measured in the same way can be detected by comparison. If space and everything in it should suddenly or gradually expand a million-fold, or shrink down to a centillionth, or alternately dilate and contract in any measure whatever, we could not discern it by any conceivable measurement.

Lorentz' hypothesis, which found great favor, was proposed in 1895. In 1904 he expressed it mathematically as a transformation of coördinates, in a memoir on "Electromagnetic phenomena in a system moving with any velocity smaller than that of light." He assumed two sets of axes, one at rest called X, Y, Z; another (X′, Y′, Z′) with the sames axes at first but with the origin moving out along the *X*-axis with the velocity *v* for any time, *t*. Plainly then the new coördinates of any point (x′, y′, z′) would be according to the Galilei-Newtonian Physics $x'=x-vt$, $y'=y$, $z'=z$, and $t'=t$, since clearly each x would be shortened by the length *vt* while y and z and t would be unchanged. But Lorentz showed that on his new contraction-hypothesis, there would result a very different set of equations, viz:

$$X'=\frac{x-vt}{\sqrt{1-\frac{v^2}{c^2}}},\quad Y'=Y,\quad Z'=Z,\quad T'=\frac{t-\frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}},$$

and these equations constitute the famous *Lorentz-Transformation.*

The next year (1905) Einstein arrived at the same transformation, in ignorance of Lorentz's work, and along

quite another line of thought. He did not think of the length along the line of motion as compressed by the motion, somewhat as an accordeon moving in the air, but as a necessary result of the *relativity of motion.* In fact, he laid aside entirely the notion of the stagnant immovable ether, assuming that there was no final system of reference at all, that one system was just as good as any other, if only it moved uniformly on a right line relatively to the other, and he laid at the basis of his whole construction these two postulates which together constitute the so-called Principle of Special (or restricted) Relativity:

> 1. The laws according to which the conditions of physical systems vary are the same when referred to *any* two systems of coördinates that are moving relatively to each other uniformly and on a straight line.
>
> 2. In a coördinate system at rest, light (in vacuo) moves always and everywhere with the same velocity *c,* no matter whether the source of light be in motion or at rest.

These two postulates Einstein then pursued into all of their logical consequences. He found they yielded the Lorentz-transformation and the negative result of Michelson and cleared up other dark points. It resulted that time no less than length and space was relative. This astonishing fact comes to light in many ways, as thus: Suppose there are two points A and B on a straight track, and let the midpoint M between them be exactly determined. Now suppose two flashes, one from A, one from B, are perceived as one by an observer at rest at M; then for him the two flashes are (psychologically) simultaneous. But now suppose at the instant of flash an observer carrying his coördinate system with him, or on a moving train, was gliding through M towards B with half the velocity of light then

he would meet the flash from B 1/3 of the way from M to B, and the flash from A would catch up with him just as he reached B. He would not perceive the flashes as simultaneous, they would be separated by an interval of time; this interval would vary with the speed of the observer. If this observer moved with the speed of light, he would meet the flash from B halfway and he would not be overtaken at all by the flash from A; he would not see it, for him it would not exist. Hence it appears that simultaneity is only relative; that just as a point is describing variously shaped and colored paths in the various coëxistent or coördinate spaces or coördinate systems, so the same event is happening at all sorts of times in these various spaces or coördinate systems. Time has meaning not at all in itself but only in the various spaces or coördinate-systems, and has different meanings in different systems.

This fundamental transformation of Lorentz and Einstein discloses various astonishing relations. The shortening of all lengths in the line of motion has already been mentioned. If we inquire into the times we easily discover that time is similarly affected. Suppose a clock beating seconds in the origin O′ of the moving system X′ Y′ Z′. To an observer in the unmoving origin O of the system x y z the clock will not beat seconds but each interval will be slightly longer, viz, one second divided by the fraction $\sqrt{1-\frac{v^2}{c^2}}$ Again, we are all familiar enough with adding velocities. If you walk forward four miles an hour in a car going 30" an hour, your total forward speed is reckoned at 34" an hour; if you walk back it is reckoned at 26" an hour. But this simple addition does not hold in the new Physics. There the formula is no longer $W = u + v$, but $W = \frac{u+v}{1+\frac{uv}{c^2}}$, where u and v are the velocities added and W is their sum. Now suppose u and v each equal to c, the velocity

of light. Then we get $W = \frac{c+c}{1+\frac{c^2}{c^2}} = \frac{2c}{2} = c$. That is, the sum of two velocities each equal to the velocity of light is still only the velocity of light. If from a gun moving with the speed of light a ball were discharged with the speed of light, as observed from without, it would not leave the gun. No additions to the speed of light can increase that speed. No speed greater than the speed of light is observable. If a body, as this rule, were to start straight up at a speed of 161,000 miles a second, its length would become only half, for the value of the ratio $\sqrt{1-\frac{v^2}{c^2}}$ would be ½. If its speed were to increase up to c, the speed of light, its length would cease to be, it could no longer be observed. Thus it appears that this speed c plays the part of infinity, it cannot be exceeded—which suggests the most heart-searching suspicions.

You are ready to say, "Oh! these things are not so, they merely seem so. The length seems shorter because it is moving so fast, the clock runs slower, because it takes some time to flash back the sign of its finger on the clock-face, the body ceases to be when moving away with the speed of light, because any flash issuing from it is borne away as fast as it approaches us and so can never reach us." This objection seems to be just, but it does not touch the nerve of the matter. For these seemings, these appearances, are after all the only evidences or signs that we have of any physical existence. The doctrine of relativity says we must take these apparent times and spaces at their face values; we can do nothing else, for we have no absolute time or space with which to compare them. As they seem so they are; there is no court of higher jurisdiction to which we can appeal.

So much for the Special-Relativity theory. It is concerned solely with what we might call inertial or Galileian

realms, as the inter-stellar spaces where Galilei's law of inertia holds, and every body is at rest or moving uniformly on a right line. You have observed that not a word has been said thus far of any force, or mass, or attraction, or acceleration, or rotation (except in speaking of possible changes of axes). But all these things are matters of experience and must be taken into account. The result therefore will be the Universal-Relativity theory. Before attacking this a word or two concerning certain profound thoughts of Hermann Minkowski, the most brilliant of recent analysts. They were expressed in a wonderful address at the 80th Meeting of the Society of German Physicists and Physicians at Cologne, September 21, 1908. Einstein has appropriated these thoughts and avows that but for them his own ideas would never have left their cradle. It had long been known that in the general Equations of Transformation there was a so-called Double Invariance: the forms of the equations of motions were not changed by any change of coördinate axes, the equations held just as well for one set of axes as for another, and secondly the forms were not changed by any uniform motion of the axes, but held as well when the axes were moving uniformly as when they were at rest. It was Minkowski's great achievement to bring out the full meaning especially of this latter invariance. He begins with the obvious fact that time and space are known in experience only together, never apart. All that happens, happens somewhere and somewhen. Also, in the equations of motion the time enters like the coördinates x, y. z. Accordingly, any point in space at any time is supposed by Minkowski to be specified not by three coördinates (x, y, z) but by four (x, y, z, t), t, of course, meaning any time-value. It is not merely a point *there* but a point *there-then,* and is called a *World-point.* The whole life, the whole career, of such a point would be the whole assemblage of all its pos-

sible theres and thens, or better, its *there-thens,* and would be a line not in space simply nor in time simply, but in space-time in a world not of 3 but of 4 dimensions. Such a line is a *World-line.* The whole of Space-Time, the whole of world-history, consists of the totality of such world-points and world-lines. But as we could not observe a single point in space or time, any single world-line would also escape us, and our observations must be wholly of the intersections of world-lines, which make up for us the whole of experience, the totality of world-events. Thus is formed a single static arrangement of all the possibilities of the universe around us, a simple four-fold picture of all that is or was or will be. In this 4-dimensional world-canvas this present meeting will appear as a highly complex knot of intersecting world-lines countless in number; any moment will appear as a cross-section of the gigantic knot. This section will not be a point, as when you cut a line, nor a line, as when you cut a surface, nor a surface, as when you cut a solid, but it will be a solid itself, with the two four-fold extents of space-time fitting upon it and separated by it. So the Conference at Paris appears as another much immenser and worse-tangled knot of world-lines in another world-region; so also the signing of the Declaration of Independence, the crossing of the Rubicon, and so on. The world-line of a point forever at rest would be a line parallel to the time-axis; of a point moving uniformly in a right line it would be a right line sloped to the time-axis. Now, however, since motion is entirely relative we may choose any point as the origin of our system of axes, and in this system at rest the point will be at rest. We ought then to be able to choose our time-axis so as to make any right-line we please parallel to it, and such is the case. In fact, by mathematical ingenuities Minkowski is able to preserve the fundamental invariances of the transformation of coördinates while placing time upon exactly the same footing as any other dimen-

sion, as length or breadth or depth. Accordingly he may then speak of before-and-after exactly as of right-and-left, up-and-down, back-and-forth, without ever making any distinction between time and space, which have thus become melted indistinguishably together. This may confound us at first, but only think that all these distinctions are purely relative. Now the ceiling is up, but on changing our origin to a higher floor the same ceiling would be down. Also by changing the origin and at the same time turning the axes the up-and-downs, right-and-lefts, back-and-forths, would all become completely fused, mixed up quite inextricably with each other. The eggs would be scrambled past all unscrambling, but the new axes would be just as good as the old; the scrambled eggs would combine into new eggs quite as pretty as the old ones. However, these new eggs would not be any better than the old. Precisely so, in Minkowski's four-fold time-space, there remains no longer any distinction of time-axis and space-axes; hence it becomes inept to speak any longer of x, y, z, and t- axes, since, on transformation t may no longer refer to time, which has become blended completely with space. Instead of X Y Z T we may better write X_1 X_2 X_3 X_4 which emphasizes the fact that the axes are quite alike, differing only in the order in which they are named. Now by change of origin and by rotation of axes any one set of axes may be transformed into any other set while still maintaining the same form for the equations of motion, still upholding the invariances that characterize the group of transformations.

Now what does this mean in ordinary speech? It means this: A man on earth and a man in the moon or on the dog-star Sirius would have entirely different sets of axes; up and down would not mean the same for the two, even as it does not mean the same in London and in Tokio, in New York and in New Orleans. Neither would sooner-and-later mean the same thing to the two men; and each

might displace his axes and whirl them about as he pleased. Nevertheless, by virtue of the invariants of the group of transformations, the equations of motion describing the time-space world of each would be equivalent. The 4-dimensional geometries of the two would be the same, and the measurements that they made upon a common object would agree at least as required by the fundamental Lorentz-equations. What then has Minkowski accomplished? He has turned three-fold kinematics into four-fold statics, and mechanics into 4-dimensional geometry. The changing universe of time becomes a single instantaneous universal presentation in 4-dimensions, where past, present, and future appear all alike, all equally real, but none absolute. It is a kind of ecstatic revelation, a stereoscopic vision of eternity in 4-dimensions. We all know how the stereoscope constructs the plane surface of the picture into a three-fold space; somewhat similarly the thought of Minkowski projects all three-fold space along a fourth axis into this hyperstereoscopic vision of unending space and time.

Einstein returned upon his problem of relativity with a mind enriched by Minkowski's ideas, which Minkowski himself alas! did not live to elaborate. Thus far the framework or system of reference was supposed to be a so-called Galilean body, that is, a body rigid and at rest or moving uniformly in a right-line; and all such systems were equally good; the equations of motion were alike for all. Such was the principle of special relativity which declared that the physical description of nature-processes remains the same no matter which of any two systems, S and S′, be employed provided only it be rigid, and the relative motion of the two be uniform and rectilinear. There is *no* preferred system, such as the ether was long supposed to be, referred to which the motions would be true and real, while referred to any other they would be only apparent and unreal. On the contrary, all motions referred to all such Galileian sys-

ems are equally real and equally justified. Now when this ostulate is combined with the second, namely, that light noves *in vacuo* always and everywhere with the same peed, then the old Galileian formulae of transformation urn into the new Lorentzian formulate, with all the re-narkable results already noted, and many others.

But such passages from one Galileian or inertial body n uniform rectilinear motion to another such, are not the nly ones imaginable, just as Galileian bodies are not the nly ones imaginable. In fact, such bodies are as scarce as ens' teeth; they are never present in our experience but re only conceptual fictions (à la Vaihinger), though none he less important and even indispensable. But ordinary odies vary endlessly in their motions. The question now rises: Is it possible to conceive and state the motions of ature so that the description may be equally correct no natter how the system of reference be moving? Such was Einstein's audacious thought, certainly one of the most dar-ng in the history of the human mind. We may say his pecial doctrine of relativity gave a formal description of ature-motions equally correct whether viewed from the op of the Liberty Statue or from an airplane sailing traight across New York harbor, but now he sought an xpression that should still be equally correct if the ob-erver were looping the loop in his airplane or tossed iolently in a storm-cloud.

The first impulse to this transcendent doctrine seems o have been given in a difficulty connected with the appar-nt increase of electro-magnetic inertia of a body in motion, vithout accompanying increase of weight, of its gravita-ional mass. These two have never been considered the ame. At a certain point between earth and moon, com-aratively near the latter, a cannonball's weight would be ero, since the pulls of earth and moon would balance, but ne explosion necessary to shoot it off with a given speed

would be the same as here on earth, for its inertial mass would be unchanged. However, observation ran to the effect that the ratio of the two masses for any body was unchanging and for all bodies the same. A wonderfully delicate experiment of Eotvös in 1891 seemed to show that the ratio could not vary so much as one twenty-millionth. It now occurred to Einstein that inertia and weight are the same thing under different conditions. The like has perhaps occurred to many; I myself have never been able to get rid of the suspicion; but Einstein assumed it boldly as the basis of a daring construction. He saw a man fall from a high building; luckily, the man was not seriously hurt, and he afterwards described to Einstein his sensations during the descent. We all know that actual weight, say at the Equator, is blended of earth-pull and so-called centrifugal force; if the rotation-velocity of the earth were 17 times as great as it is, it would completely annul the earth-pull, and the hugest stone would be lighter than a feather. Now suppose a large chamber in a Galilean field, that is, either at rest or moving uniformly and straight; let an angel or one of Maxwell's "demons" seize the chamber by a hook in the top and bear it aloft with constant pull, that is, with constant acceleration, with steadily increasing speed. How would the man feel? Lighter than a feather before, he is now heavy; he feels in feet and legs the upward push of the floor; he presses on it, and so does everything in the chamber; if he lets anything go, it drops to the floor and all things precisely alike. If he fastens a cord to the top and any body to the cord-end, the body hangs down, the cord is tense. In fact, for all possible observation he finds himself in a gravitation field, solely in virtue of his uniformly accelerated motion.

Of course, it has long been known that the straight path of a projectile (say) in a Galileian field becomes a curve (as a parabola) in a gravitation field; it remained for Einstein

to apply the principle to light. Fifty years ago Maxwell showed that light must press longitudinally, along its rays, against the mirror it strikes; thirty years later this was verified experimentally by the Russian Lebédev and still later, in 1904, and still more accurately by the Americans, Nichols and Hull. But this pressure was due to the light's electromagnetic energy, which endows the light with inertia-mass; did it also have gravitational mass, that is, weight? According to Einstein's so-called *Principle of Equivalence* (of an accelerated Galileian field to a gravitational field) the light must have weight, and a star-ray must be bent sunward in passing near the edge of the sun, so that to an observer on earth it would appear displaced from the sun about 1″.74, just twice the calculated Newton-Maxwell displacement .87″. It is the striking confirmation of this prediction in the British observations on the total eclipse of May 29, 1919, that has so startled the world. But if the light is bent its speed must vary, contrary to Einstein's fundamental assumption; but this was made only for Galilean fields and does not hold for intense gravitation fields. Modifications must be continually introduced into growing scientific structures. For the simpler case, earlier treated, is later perceived to be only a limiting extreme case of a more general and complicated one—into which it is merged not as a contradiction but as a particular under a universal, and it can hope for no kindlier fate.

So much for the uniform gravitation field equivalent to the uniformly accelerated Galileian field. But here on earth the gravity field is not uniform; a body's weight varies from point to point, it is less on the equator, greater towards the poles. So the solution of the problem is only started; how are varying gravitation fields to be treated? Still another difficulty before trying to solve this. We have seen that the actual gravitation field, as at the equator, is a blend of gravitation and rotation. Consider now how this

rotation must affect time-space measures. Suppose a man on a disc that rotates steadily like a merry-go-round. To himself he is at rest but pulled towards the rim; to an outside Galileian observer he is in uniform circular motion. Let the man set down two similar clocks, one on the rim, one at the centre. To the Galileian the moveless central clock runs faster than that on the rim. So also to the disc-man, who would count himself at rest wherever he stood, his clocks would vary in rate from point to point, and time would mean nothing definite, and neither would the phrase "at the same time."

Now let him measure lengths on his disc, and let the Galileian observe him. To this latter the foot-rule at the centre is shortened when laid tangentially on the rim in motion, but not when laid on the diameter of the disc, at right angles to the motion. Hence the rim turns out longer than in a circle at rest, and the calculated value of the perimetric ratio π would be greater than our familiar 3.14159 ..... So then the Euclidian geometry would not apply, the rotation would expand the circumference leaving the diameter unchanged.

If such be the effect of rotation with its so-called centrifugal force exactly the opposite must be that of centripetal acceleration in a gravity-field, as when a mass particle is at the centre of the disc: all radii being in the direction of the varying motion would be shortened in the varying fraction $\sqrt{1-\frac{v^2}{c^2}}$, while all circumference or tangential elements would remain unchanged; hence the unit used in measuring the circumference would be shortened in measuring the diameter, so that the ratio would fall out less than 3.14159....., the circumference would be in effect contracted as regards the diameter, an extremely important fact to be noted hereafter.

The fundamental insistent question now recurs: Can we find a space, a scaffolding, or set of coördinates that shall be related to this world of rotations and central accelerations as the rectangular axial system is related to the Galileian inertial world? In this latter all rectangular systems are alike justified, the description of an event in any one is quite as correct as in any other. In our actual centripetal-centrifugal world are there any corresponding systems, all alike valid for the description of events? That is, in which the equations of motion do not change form on transforming coördinates from system to system? The answer is, yes! They are highly generalized coördinates called Gaussian, from the Göttingen prince of mathematicians, Carl Friedrich Gauss. We all know so-called coördinate paper. Imagine a sheet with the lines as close as you please, each line numbered; each point on the page is fixt as the intersection of two such lines, U and V. Think now of a curved surface covered with such a double system of lines, parallels of latitude and meridians of longitude, similarly numbered and named, each line of each system intersecting each of the other, but none of its own system. Now suppose the paper or the sphere-surface distorted in any way. The double system of lines will be deformed but will determine the points of the surface precisely as before, the point (5, 7) will remain the point (5, 7). The two essential conditions are maintained, namely: Each line of each system intersects each line of the other system in one and only one point, and by making the distance as between two points P and P′ small at will the differences du and dv of the corresponding coördinates may be made small at will.

What has been said of surfaces holds just as well of 3- or 4- or n-dimensional extents; the Gaussians define points in all just the same way. Think of this room as filled with fine spider-threads, 3 systems, u, v, w, from wall to wall; up and down, east and west, north and south—so

that through each point in the room there shall pass one and only one line of each system and in each system let all the lines be numbered exactly. Also suppose the room filled with jelly, to keep each line in place. Now let a September tornado strike the room and twist the jelly mass into any shape but not tear it at any point. Then the lines will be contorted every way, but their intersections remain definite, the point (3, 7, 9) will still be the point (3, 7, 9). Now expand your imagination from the room to all space, with the same systems of lines or Gaussian coördinates, u, v, w. And now suppose a fourth system added, the time-system t, giving a four-fold determination in the four-fold time-space world. Then you have the coördinate system used by Einstein. In its use he employs the most powerful and refined mathematical methods of the Italian analysts Ricci and Levi-Civitá, and his stupendous problem is to find such a four-fold system of Gaussian coördinates as shall enable us to represent in equations the complex positions, velocities, and accelerations at any and all instants and on transformations to any other four-fold Gaussian system shall continue to represent them with the same exactness. How he solves the problem by the agency of invariants and covariants and contravariants and fundamental tensors and other such enginery of analysis cannot be set forth now and here; suffice it, that by means of covariance in a certain quadratic differential of four terms, and by means of tensors, that is, expressions such that when a linear relation connects tensors of the same character in one system of coördinates it connects them in all systems, he arrives at laws and equations that do not contradict the Newtonian but include them as special extreme and limiting cases. Thus, Einstein's two equations for the motion of a particle in a plane gravitational field agree with Newton's, except in the addition in one of them of the extremely small term $2\,m\frac{h^2}{r^3}$. But this

happens to be just enough to explain numerically the 43″ per hundred years of rotation of the orbit of Mercury, which Newton's equations left unexplained.

Other examples could be given, but it is not in this higher arithmetical accuracy that the supreme interest lies. The important point is that the jelly-space through which the Gaussians run and always hold their own need not be Euclidian; in fact, the new physics does away with the notion of *force,* along with nearly the whole conceptual apparatus of the elder mechanics and describes the motions of nature as being what they are, and as simulating the operation of forces in Euclidian space, *by virtue of merely taking place in non-Euclidian space,* in space that is curved and crinkled like the surface of the sea—in fact, as it were in a jelly-space that has been twisted and strained but not rent by a tornado. No one balks at a crinkled sea-surface, but many balk at a crinkled sea-solid. The difference is not logical but psychological, in our depictive power. A three-fold space may be curved in a four-fold space quite as well as a two-fold in a three-fold, or a one-fold in a two-fold. So much admitted, and it must be, it then follows that the necessities for gravitative and doubtless other forces in the old physics lay in the hills and valleys of space itself—as Homer would say, "In the numberless folds of Olympus," that is, of the starry expanse.

It is not then that the particle at the sphere—or circle—centre attracts other particles around it, but this particle is a *fiction* (as Vaihinger would say) now to be supplanted by the superior fiction of a curvature in that particular region of space or rather time-space.

This all-important conception of matter as essentially a phenomenon of irregularity in the curvature of space may at first blush revolt the reader, and it may be well to prepare his mind by reference to certain familiar analogous facts. Imagine a circle in its plane; it is smooth, it has the

same curvature at every point; an experience confined within it would have no sense of resistance or urge or irregularity of motion. Similarly on a perfectly smooth sphere-surface, everywhere equally curved. But now suppose the curve not exactly circular but set with minute unequal aufractuosities here and there along its whole length; then in such an experience confined to such a deformed circle a sense of resistance, urge, or unequal motion might well be present. Similarly, if the sphere-surface were not smooth but indented irregularly like the rind of an orange, an experience wholly therein might well involve such ideas as effort, restraint, and varying motion; more accurately, such ideas or experiences might well be interpreted or symbolized under the form of such varying curvature. Now on passing to three-dimensional space the analogy holds perfectly. We must remember that the curvature of such a space is definable and expressible quite as precisely as the curvature of a curve or a surface; and that our three-dimensional space must or may be thought as a border between two four-fold extents, just as the circle is a border between two plane surfaces, its inside and its outside, and the sphere-surface as a border between two solids, inside and outside; also that the plane touches the circle in and out along its whole length, and that solid space touches the sphere-surface, in and out, at every point. Likewise we must think of four-fold space as touching our (three-fold) space at every point and the curvature-irregularities of the latter (its matter-points or regions) as jutting into four-fold space this way and that, forming dents and jags (sharp curvatures) much as the bends, highths, and hollows on the circular curve and the sphere-surface. In such a three-fold space, rugged as a mountain-range, all the phenomena of molar and molecular mechanics, of force, mass, energy, and the like, might well present themselves in experience as characteristic of pure motion.

But the reader will still insist that motion implies *something that moves,* and that this ever persistent something is precisely what he calls *matter,* and is not any flexure of space in which the motion takes place. This objection borrows all its vesture of extreme plausibility from the fundamental assumption of the "natural man" that the reality of the physical world around us consists of *objects* (Kant's "things in themselves") that are what they are independently of mind, soul, or spirit, which merely perceives them and pries into their properties as best it can. Now it is exactly this *Thing-ism* that Einstein's Relativism refutes and expels from Philosophy. Even his doctrine of Special relativity accomplishes this, for it shows that the length (and therewith every dimension of a body) belongs to it not in itself but only as a relation of observer-and-observed and may even vanish under certain conditions of motion. The general theory of relativity takes another long step forward in resolving *thing-character* into *space-property,* in particular, into curvature.

Nevertheless, the reader will remain unsatisfied until he takes the last decisive step towards a positivistic idealism and definitely recognizes that the objective character of the *mover* is only a construct or objectification of psychic activity, of spirit itself. It is not enough to say with Kant that the subject imposes its own conditions or forms of time and space upon the material of sensation freely offered it in experience. This still leaves untouched the independent objective datum, the main source of the woes of philosophy; besides, it is not possible to assign any satisfactory meaning to this imposition of time and space (as forms of intuition) upon the stuff of experience. Nay; the *objects* in question are not the *discoveries* but the *creations* of psychic activity, they are not merely objects but also *objectifications,* for the basic law of spirit-activity is to project, to construct, to image, to *objectify.* Time and space and the categories are

forms or ways in which this continuous externalization takes place, as indeed, in a more refined sense, are all science, all art, and even all history. The varying curvature of space, which gives rise to the notion of permanent objective independent matter, is the image, construct, or objectification of the diversified manifold nature of spirit (or psychic activity) itself, and the conservation of mass and energy is the construct or symbol of abiding unity amid such unending diversity. As Goethe has so impressively declared:

> And all the wide world's wild commotion
> Is endless rest in God the Lord.

To return from a long but important and even necessary digression, we have in fact seen how the centripetal acceleration works in effect a contraction of the circumference and a diminution of the ratio π. A similar change we actually know very well here on earth. From the pole as centre with a quarter-meridian as radius we may draw a great circle on the earth-surface, namely, the Equator. This latter is in length π times the diameter measured *through* the earth, but it is only two times its own arc-diameter measured *on* the earth, through the pole. If we trace a small circle, a parallel of latitude, similarly, we find its ratio to its arc-diameter on the earth is still less than π, but approaches the value π as the circle shrinks up closer and closer round the pole, and very near the pole the value would be indistinguishable (by measurement) from π. You say, "But the arc-diameter is not the real diameter." Very true, if you pass from the earth-surface of two dimensions to the interior earth-space of three. But if you know nothing of that interior three-fold space, and stick to the earth-surface, then your arc-diameter is the only diameter and it functions in your surface-space exactly as a straight line, and on this earth-surface the ratio of circumference to diameter would always be found less than π, but approaching π for

all very small circles. Now as our two-fold earth-surface is curved in three-fold star-space, so may our star-space be curved in four-fold space; and so may our four-fold space-time be curved in a conceivable five-fold space. Accordingly, there is nothing bizarre in supposing that gravitation around and towards the sun is only a dynamical way of stating the pure statical geometric fact that the sun is the name for a certain hump or ridge in space in whose neighborhood the curvature is marked and the circummetric ratio is less than 3.14159. . . . If a path were drawn around his hump 1, as the orbit of Mercury, it would be shorter than the corresponding ellipse calculated by Newton and Leverrier in Euclidean space; if we take this ellipse, cut it at one point, straighten it out, and then bend it along on the orbit or path of Mercury round the hump, it will lap over very slightly at the end, and this slight excess of 43″ per century appears in the discrepancy for which the old mechanics could not account, but which the new mechanics explains without remainder.

There are various other considerations that urge upon us this conception of our space as curved and finite. Finite, but not bounded. This important distinction was clearly drawn by Riemann. A circle or any closed curve is finite but has no bounds. A caterpillar may crawl round forever on the rim of a small tub and may very properly fancy he is taking an endless but not an infinite journey. So a football surface is unbounded; an ant might hurry and skurry over it forever without stay or hindrance, and construct an admirable two-dimensional geometry; but the surface is not infinite, it contains just so many square feet, no more. Similarly our space may be boundless but yet finite, having just so many cubic miles.

Grave difficulties meet the supposition that our space is infinite. For if attractive matter were scattered throughout with any finite average density d, however small then

the attraction at any point would be infinite. For describe around any point an enormous sphere of radius R. The attraction at the point would vary as the mass contained,—that is as $d \times R^3$,—divided by R^2; that is, it would vary as R, and would increase with R beyond all limit. This cannot be, hence the mass cannot be spread, however thinly, through infinite space. Hence it has been supposed that the starry universe, the world of matter, is a disc-like island in an infinite ocean of emptiness; and Seeliger especially has tried to modify the Newtonian law of inverse squares; but none of this satisfies. It seems better to assume the indicated spheroidal form of our space, to suppose it is Riemannian rather than Euclidean. Let us suppose that spider lines or light-rays issue from a point P in every direction. On each one measure off a distance R. The ends of all these measures will lie on a sphere of radius R about the center P. Let R increase. In Euclidean space the surface would grow larger and larger, always equally $4\pi R^2$. In Riemannian it would not, but would attain a certain maximum and then shrink down to a point. The surface of a sphere would be $4\pi R^2 \sin X^2$; and as this angle X increases from 0 up to 90°, the sin X rises from 0 to 1; as it increases from 90° to 180° the sin X shrinks from 1 to 0. Precisely so, if you describe circles about a pole on the earth-surface, the circle—length will be always $2\pi R \sin X$ (where X is the co-latitude); this sin X increases from 0 to 1 as X increases from 0 to 90°; there the circle is the Equator $2\pi R$; from this on, the circle shrinks as X increases from 90° to 180°, and finally shrinks to a point in the opposite pole. Exactly so, if our space be curved and Riemannian; its volume will be $2\pi^2 R^3$, and the value of R turns out to be simply related to the average density d of matter, namely: $R^2 = \frac{1.08 \times 10^{28}}{d}$ metres. Naturally this squared radius varies inversely as the density of matter,

for *presence of matter* is only a fictitious way of naming the *fact of curvature.*

There is then nothing outré or outlandish about this notion of curved finite space of 3-dimensions and of space-time of 4-dimensions; it is only a natural extension of the notion of a sphere-surface, of a curved finite space of 2-dimensions. But we need no more suppose that this finite space is exactly spherical and smooth-curved everywhere alike than that the earth is exactly spherical and perfectly smooth. On the contrary, the unequal and indeed irregular distribution of matter is only an aspect or symbol of the irregularity of curvature, which is itself the symbol or objectification of singularity inherent in the constructive soul. As the density of matter is never very great, so neither is the curvature anywhere very sharp; space spreads out like a mighty Pacific scarcely so much as fretted by a summer breeze. As Homer says, "Out from the current profound of the River unrippled of Ocean."

Even after leaving out the most that was first written down, the time is well-nigh out and little is left for discussing the "philosophic implications," the main theme originally in mind. Einstein himself never mentions or hints at any; he is obsest with measurements, with his rods and clocks and signals and his purely mathematical apparatus; but Max Planck, the father of the quantum, justly likens Einstein's revolutionary thought to that of Copernicus, as "surpassing in boldness everything previously suggested in speculative natural philosophy and even in philosophical theories of knowledge," in which judgement J. J. Thompson seems to concur. For my own part, I can hardly be a fair, even if I were a competent, judge, so completely and perfectly does the Einstein theory fit in with the general world-view that I have long cherished and am gradually shaping into expression.

For assuredly the rigorous and uncompromising doctrine of universal relativity leaves no escape from the conclusion that the subjects of its treatment are themselves the creatures of the intelligence that so boldly, so audaciously manipulates them, in whose hands they are more plastic than wax, being fused and compounded and contorted at will, to depict and reflect the purely analytic properties of a group of coördinate transformations. If the elements of the time-space world were themselves the inflexible constituents of a world self-existent and independent of the intelligence that was merely contemplating their play on the stage of the physical universe, then indeed all this metrical-mathematical prestidigitation of Einstein's would seem to be as insolent as it was meaningless and absurd. He would indeed seem to be more ridiculous than a dog baying at the moon. But the case is altogether another if the time-space world be itself the obedient creature of mind, the construct of intelligence itself, which has brought it into being as its own self-expression and which is pursuing its age-long, its eternal, task of reducing that construct to an order and system that shall be perfectly rational and self-consistent, that is, that shall symbolize in all its structural details the harmony, the diapason, of the universal soul. Accordingly, the Einstein theory would appear to be the latest and the longest step ever taken in the rational organization and interpretation of human experience. This experience, insofar as it is conscious, seems to begin with the most formless and undifferentiated sensations; it advances to ideas, to *Vorstellungen,* in the creation around us of the perceptual, particularly, of the visual world, and through this it moves on still higher and further to the fashioning of concepts, to the splendid architectonic of science and philosophy. As intuition to the world of percepts, so is theory to the world of concepts. It is in this third heaven of spiritual energy that Einstein and the lamented Minkowski have

celebrated their marvelous triumph. But it must not be supposed that this triumph is by any means complete or final. There are not only many problems still unsolved but many that can hardly as yet be stated. However, the indication seems clear that the physical world must henceforth be regarded as a sacrament, as the outward sign of an inward grace, as the shining symbol of one all-pervasive spiritual activity. Not only then do all the physical sciences in turn merge into mathematics, but mathematics itself, their queen, is merged in logic, and logic is the return of psychology upon itself, and philosophy is the deep-eddying ocean-stream engirdling and engulfing them all.

WILLIAM BENJAMIN SMITH.

TULANE UNIVERSITY.

LEIBNIZ ON TRUTH AND BEING.

WE take Leibniz on Being first. Being is central in the system of Leibniz. Being, with its various kinds or categories was central in the systems of the great thinkers, from Plato and Aristotle onwards, as was pointed out by Trendelenburg when dealing with the history of the categories in the first volume of his *Historical Contributions.*

Formal logic and mathematics were highly significant for the thought-development of Leibniz, and for the method of upbuilding his system, but this, which relates to the form of his philosophy, is of quite subordinate importance in relation to the contentual side of his system. I am not, therefore, concerned with the rather extravagant claims which have been made, from the formal or methodic side, by thinkers so distinguished as Couturat and others, for logic as heart and soul of his system. The thinkers who have put forward these claims, it is enough now to remark, have themselves, in respects important for my purpose, done a good deal to upset them by admissions of the unfruitful character of the Leibnizian logic. It is not surprising in one who was the greatest mathematician of the rationalist philosophers of the seventeenth century, that his logical theory should have remained mathematical to the core, however concrete the uses to which he put it. Leibniz claimed, strange as it sounds, that his metaphysic was

wholly mathematical, and that mathematicians had as much need to be philosophers, as philosophers had to be mathematicians. And the contention has since been made that the interpretation of his system must depend entirely upon his logic.

For all that, the real or contentual side of his philosophy can still be studied apart from such complete dependence on the place logic had in the formal aspects of his teaching. The excessively deductive method of his system is not denied; but Leibniz was admittedly not the man to sacrifice or efface the real; and while an internal, and not merely exterior, connection must be held between his logic and his metaphysics, it must nevertheless not be overlooked that the materials for his system were drawn from the sciences of the real. This is to give Leibniz credit for seeking to do justice to the claims both of the formal and of the real sciences. It must be remembered, too, that Leibniz was metaphysician more than psychologist, and saw things in their relation to the whole. To him pure ideas—such as those of being, unity, identity—did not depend upon the senses. Being was realized for Leibniz in the monad and the monadistic system. The conception at which Leibniz arrived was that true being is ontological; it was for him metaphysical being, in the sense of activity. From his early studies of Aristotle and the scholastic philosophers, he came to what appeared to him as the finally valid result, viz., that being is strictly metaphysical, as force, activity, substance. That we come upon idealistic elements in it so soon as we enter the peculiarly metaphysical territory, need not, it has been urged, affect the epistemologically realist position or relation. Thus matter and extension, space and time, *e.g.*, were, it is contended, only well-founded phenomena, appearing first in the complicated sensuous intuition, but did not arise from the side of the thing itself. There was no question of idealism or realism, while the

and yet, though without "windows" it is supposed to cognize by its own perception, the being of other monads. Each is a "living mirror" or a perpetual image of the universe. The monads vitalize all matter, but in varying degrees of intensity. Rational souls are monads, and are marked by activity. Leibniz says he was led to regard the activity principle as a simple, unextended one, and to apply it to the monads, because he had found it impossible to find the principle of a true unity in matter, or in anything merely passive. All created substances were thus, for Leibniz, active, not passive or inert, as they had been for Descartes.[4] Force being for Leibniz unextended and immaterial, substances had to be immaterial, that is to say, purely psychical forces. The essence of his monads or simple substances was just such psychical force or activity. This psychical force he applies to all nature. God is the supreme monad, most vital and active of all. If all the monads were destroyed, Leibniz holds that this central monad would still contain within itself the whole infinity of existence. This shows it is an ideal universe Leibniz is constructing—not the real universe, but one without experiential basis, which he is seeking to impose upon the existing universe. Rational monads are to him God's agents, sub-rational monads are His instruments. The Supreme Substance is for Leibniz "unique, universal and necessary," nothing outside it being independent of it. Also, it is "illimitable" and "must contain as much reality as is possible." In short, in God as the supreme substance, "perfection is absolutely infinite." Thus God is the primary unity and the original substance. Of created or derivative beings, Leibniz holds their perfections to be through God, their imperfections are "from their own nature." But they have a power of aspiration according to the degree of perfection they possess.

[4] Substance was thus *ens praeditum vi agendi*, to Leibniz.

The existence of the supreme and necessary Being is held by Leibniz, as we shall see later, because, if He is possible, He must, in his view, necessarily exist. As He is without limit, negation, or contradiction; His essence is identical with existence. As to the monads, we saw that they are characterized by activity; this activity is the way in which their individuality—a prime concern with Leibniz —manifests itself. Being is, in Leibniz, drawn out of doing.[5] It is, as active, that the monad has clear and distinct ideas; confused and obscure are its ideas, when passive. The field of such obscure apprehensions, with their power of developing into conscious cognitions, is to Leibniz immeasurable, while clear apprehensions constitute but a few points, he thinks, in our whole mental life. These subconscious sensations[6] occupy a curiously central place, due to a real insight, in the psychological theory of Leibniz. To him, the essence of the monad lay in perception and appetition; and the life of the mind consisted in progress from confused to more distinct perceptions.[7] These "small perceptions" have more effect, Leibniz contends, than we think, for, though unconscious or unfelt, they "indicate and constitute," he says in the "New Essays," the identity of the individual, who retains the traces or expressions of his previous states. As applying to his monads, or ultimate principle of being, Leibniz put forward his Principle of Sufficient Reason, his theory of the sameness or identity of Indiscernibles, and the Law of Continuity. But these three are virtually one, the second and third being necessary corollaries from the first, the principle of Sufficient Reason. By that principle the determination of an effect involved not only logical necessity,

[5] *Quod non agit, non existit.*
[6] *Petites perceptions.*
[7] The inherent activity and native endowment of the mind were expressed by Leibniz in his reply. *Nisi intellectus ipse,* to the Lockian aphorism, *Nihil est in intellectu quod non fuerit in sensu.*

but, as it has been put, "the selection of the best out of an infinite number of logically possible alternatives." The principle of sufficient reason was, to Leibniz, the true motive of world-construction. For the sufficient reasons Lewes, it may be remarked, proposed to substitute "ratios or equivalent values."[8] The view of Leibniz, it may be remarked, that there would be no sufficient reason for two indiscernible beings is really extrinsic to the question of their intrinsic possibility. The metaphysical possibility he did not deny. His Law of Continuity rejected a gulf, or *saltus*, between unthinking matter and unextended thought. Monads, he held, could act on each other only ideally, and not by impact; there was no real interaction between them; if they seemed to be governed in any case, it was because the parts acted harmoniously together, as though directed by a central power. The activity or effort of the monads was thus exclusively immanent in its effects. The ideas of the monad followed a law of its own nature. Transitive activity[9] was denied in its very possibility. But this theory of the substantial independence of the monads does not tell how we are to explain the fact that things do, in actual circumstances and conditions, appear directed towards each other, stand in actual dependence upon each other, and are brought, under scientific inquiry, to reveal intimate causal relations. It casts no explanatory light on the causal, law-conformed connection of things. The unity of this pluralism is inadequate. This inter-connectedness of things in themselves is not satisfactorily explained by simply falling back upon a unified World-Ground, Who relates things to each other, and binds them into a world-whole. The truth is, Leibniz took not the trouble to give us a real and ordered definition of what the monads meant to him. Hence Schopenhauer said he could form no clear notion of the

[8] *Problems of Life and Mind*, Vol. II, p. 94.

[9] *Actio transiens.*

monads of Leibniz, "which are at once mathematical points, corporate atoms, and souls." Again he speaks of the monads as "that monstrous identification of two absurdities, namely, of the atoms, and of the indivisible original and essentially knowing individuals, termed souls."

The question of personal agency, including that of causation, was a deeper and more complex affair than Leibniz realized, with his inadequate notion of what his simple substances involved. If all bodies are compounded of the mounds, they might appear to be matter. If they are viewed as parts of substance, they might be taken as metaphysical, since substance is to Leibniz spiritual force. The monad is a living soul or being, and, as such, may be viewed as metaphysical. But again, the monad is the basis of all reality, and, as such, may be regarded as something real. The conception of the monad is so ill-defined as not readily to lend itself to agreement of the possible conflicting views. There is, I think it must be held, a manifest lack of immanent and essential bonds between the monads. The activity of the monads was perceptive and appetitive, representation and appetition being, as we have seen, their fundamental functions; as cognitive or representative, each mirrors all other monads, and each is miniature of the universe. Indeed, one German interpreter of Leibniz carries this so far as to say that the concept of representation is the most important one for the monadistic system of Leibniz. But it seems hardly an adequate fulfilment of the conative emphasis in Leibniz. Perception of the past, or memory, be held to imply real or personal identity. There were, to Leibniz, as many degrees of perception as there are ranks or stages of monadistic development. The lowest stage—that of "naked" monads—was, in his view, one in which cognition is as confused as in the swooning condition or in dreamless sleep. This is the stage of inorganic nature—the mere analogue of spiritual life—

where consciousness is never attained in any but infinitely small degrees, and the form of expression for the monad is that of motion. But this postulation of confused perceptions is not very satisfactory, if they are to be taken as perceptions that are not conscious. Inorganic nature, is, in the view of Leibniz, an aggregate of sleeping, or undeveloped, monads; man is a waked up monad, distinguishable, in his system, in degree rather than in kind.

By his expositions of the law of continuity, and of the harmony existing in the universe, Leibniz rendered no small service in setting out, after his own fashion, the intelligibility of the world and its relative perfection. But his pre-established harmony was really too complete. His theory of pre-established harmony was merely an idea to compass agreement between ideal thought and real being, while he formulated a world of his own, with elements drawn from both. But the results could not be congruous. These, and other considerations, must not be left out of account when we are asked to credit Leibniz with an idealistic metaphysic, in which the world is taken to be composed of psychic values, thought of after the analogy of our own inner experience. Here, of course, it must be recognized that to Leibniz, at the outset, reality could only be comprehended by reason or thought, experience being held of subordinate importance; and it was by conceptual method, and through ontological speculations, that Leibniz deduced his whole monadistic system. And it must be recognized how much freedom from contradiction in a concept, and the category of possibility, counted for him in the passage to real existence. In such ways metaphysics became so much an activity of pure thought, as to be near of kin to mathematics, which latter was all-important to him. To him, also, body and soul were so independent, that "every body acts as if there were no soul, and every soul acts as if there were no body, and yet both act as if each

was influenced by the other." Yet to Leibniz the soul is never found without its corresponding body.[10] And each body is regarded as a multiplicity of individual souls or substances. That each part of the universe should so completely harmonize with every other part, and that without any mutual dependence or interaction, is all a shade too inexplicably perfect and complete. There is more than a touch of the fanciful at times in the philosophy of Leibniz, but his prescience was undoubted in matters that bore significantly on the speculative theories of scientists of much later times. His philosophy is biologic in type; to him there is nothing really inorganic; all nature is living. This, in contrast with the geometric type in Spinoza. But Leibniz spoke, on occasion, of Jehovah as the eternal Geometrician. The prescience of Leibniz predicted, from the law of continuity, the discovery of polyps, which he deducted as a concept. But the evolution of Leibniz was an unfolding of what was potentially present from the first, it was not of the nature of epigenesis. Darwinism, on the other hand, held that "the germs or gemmules of each separate part were not originally performed, but were continually produced at all ages during each generation, with some handed down from preceding generations."

The existence of God was, to Leibniz, ontological, as it had been to Anselm, to many of the Scholastics, and to Descartes. But as against Descartes, Leibniz urged that the concept of the Highest Being must first be shown to be possible, or without contradiction. But Leibniz held that God, if He be possible, exists. The significant thing, for our purpose, is that Leibniz, like those other rationalists, Descartes and Spinoza, believed that he could conclude from concepts to existence. Kant himself appealed to the principle of thought-necessity on the ground that it

[10] Rosmini reproaches Leibniz for inability to conceive spiritual intelligence without body.

is objective, yet Volkelt said that the principle Kant employed against the ontological argument meant absolute scepticism. The ontological proof of Leibniz is a new proof of both aspects of his theory of knowledge, namely, his realism and his rationalism. It throws him back on the Cartesian-like position that one must, by analysis, form a clear and distinct representation of the object. And as to the certainty of other things, Leibniz expressly says he does not think anybody will be so seriously sceptical as to be uncertain of the existence of the things he sees and feels. He also maintains that things are the causes of the representations. In such matters, he occupies very much the ground of the Scholastics, and indeed approximates the positions of many modern realists, like Hartmann, Messer, Külpe, etc. These are, at any rate, the usual or main insistences of Leibniz.

When it comes to the question of the relation of God, the Supreme Monad, to the monads, it cannot be said that His relation is a very direct or active one. Indeed, after all is said, his doctrine of Deity remains rather obscure. No doubt, Leibniz usually declares God the sufficient reason[11] of all the monads, but too often it is really the final cause of a thing which he takes to be its sufficient reason. It does not, in rigid consistency, appear as though his system had any particular need of the God of theism, for by his doctrine of pre-established harmony in the system of the monads, not much seemed left for God to do. Of course, it can be said that the pre-established harmony was itself the work of a transcendent Creator, but the transcendence still appears as of a deistic kind. The effect of this rather arbitrary and artificial pre-established harmony is, I think, softened, and rendered more natural, in the light of some of the recently edited texts of Leibniz, to which I shall refer presently. In these, Leibniz formulates the

[11] *La raison suffisante.*

law of harmony as a universal law and illustrates its actual working in a variety of ways, and its applicability to particular existences. Harmony is the law of being, a law of intelligibility. The notion of harmony is a rich and complex one. God is for him the ultimate cause of all the harmony of things. Mind being the principle, he says, of unity, all matter implies a mind. But the rigorous development of the notion of harmony is what characterizes these recently edited texts. The "pre-established" character or aspect of the Leibnizian harmony is, however, objectionable. It seems to cancel freedom, and settle all things in advance, rather than leave the future issues to be worked out in a harmony of wills. Leibniz held that God had not only foreseen everything, but provided for everything. What truth his pre-established harmony did contain was that, in the original constitution of things, there are things that fit into each other without a cause and effect connection. What his theory did not take account of was, that there are natural agents so constituted that they act on each other in relations that are properly termed causal. This his monadistic system excluded, allowing no real interaction. But it allowed to every monad that within its limits it could attain its own determined degree of happiness and perfection—a eudaemonistic tendency, of course. We may alllow the whole theory to be free of logical contradition, but, as applied to the actual universe, it breaks down from sheer complexity. And science will not brook its disallowance of interaction. The monad we are compelled to regard as in reality, and by its very nature, a self-transcending conception, since its agency is found in what is actually an interacting system of mutually modifying agencies. His universe, with its too extrinsic unity, still appears as a too pre-ordained and mechanical concern, wound up too completely at Creation, and doing its pre-

destined work through monads all too exclusively shut up within their own consciousnesses.

Leibniz held a mechanistic view of life. All happens mechanically in Nature, he says, but the mechanical laws spring out of a higher law of purpose. It was very distinctive of the philosophy of Leibniz that it sought to harmonize the mechanical cast of the universe with the teleological view of it, and this he did by subordinating mechanicism to teleology. In this reconciling aspect, Lotze is just a more modern Leibniz, only showing advance in his theory of soul. But already, by his own definition, Leibniz made the monad a "spiritual automaton," for the mechanical laws applied, in his view, to living beings and not merely to nature-events, and he denied the monad any knowledge of outside existence and order. No cosmos could possibly arise out of such wholly exclusive beings as his monads, if he had rigidly and consistently carried out his own postulations. However, he found the Divine aims to be realized in Nature, and this through the uninterrupted interconnection of all things. For the individual being or monad constituted a little world by itself, yet its development was supposed to be in harmony with the development of all other beings or monads. For they all had a common origin. They proceeded from God by an emanation or fulguration. But it is yet the mechanical interconnection of Nature with which the philosophy of Leibniz is concerned. Leibniz held God to be the first reason or cause of things, absolutely perfect in power, wisdom, and goodness, and declared the Divine purposefulness in Creation. All the Divine working is, in his view, in accordance with the principle of sufficient reason; for if God "has chosen one less good, there would be something which might be improved in His work." Hegel, however, thought that Leibniz had merely asserted, but not proved his position. The whole monadistic system of Leibniz, with its interesting blend of specu-

lative freedom and scientific restraints, is the result of his ingenious attempt to harmonize Plato with Democritus, Aristotle with Descartes, and the Scholastics with the moderns. But it is honeycombed with inconsistencies, as might be expected. It does not satisfactorily explain how his self-acting, immaterial force can really constitute the plurality of real, imperishable entities with which it has to do, so wondrously dowered as they are supposed to be. It does not explain the extended perceptions of those wholly unextended entities, the monads, nor the other unexplained matters already noted. And there is, further, no adequate account of what, after his manner, we should have to call the world's pre-established discord—its deep moral evils, disharmonies, and irrationalities. Leibniz seems to have thought a great deal more could be deduced by conceptual thinking than was at all possible in the case of the real world. Kant saw how impossible this sort of procedure was, without sense-material being properly given in experience. But Leibniz did not see how his psychical substance, as such, could never possibly produce the world. Psychic force, without raw material of some sort to work upon, could do nothing of the kind. And of the causation necessary to effect the changes in phenomena, Leibniz had no satisfactory account to give. Nor is it matter for surprise that exception has been taken to the way in which Leibniz, so finely and purely intellectual in his great mathematical and metaphysical speculations, yielded to a pragmatic tendency in the latter, and wrote his "Theodicy" in a too practical and accommodating spirit. He also, I may add, describes in this work the Divine intellection in a very human and gratuitous fashion, ascribing to the Divine Mind a plurality of acts which are the merest postulations of the philosopher himself. But there are good things also advanced by Leibniz. He suggestively remarks on the Anselmic proof that "if *Being in itself* be impossible, all

beings through another are so also;" and thus nothing could exist. And again he says "if necessary Being does not exist, there is no being possible."

Couturat's estimate of the philosophy of Leibniz is, that it is the most complete and systematic rationalism; that there is in it perfect accord between thought and things, between nature and spirit; that in it reality is wholly penetrable to reason, because penetrated with reason. Panlogism is, in his view, the only term for this metaphysics. That is an admirable estimate of the system of Leibniz from the formal or logical side, but it does not appear to me to take due account of, or at least sufficiently express, the real side of the philosophy of Leibniz—the side of the metaphysics of real being (of absolute and necessary existences and of contingent or real existences), which is so conspicuous a feature of the thought of Leibniz. This is not to deny that the universe of truth is, for Leibniz, wider than the real. He started from what forms the possible to pure thought, that he might determine, in *à priori* fashion, the nature of the real. But that is no reason why we should forget that such concepts as the real, and objective being, and such categories as unity, substance, existence, necessity, contingency, were not to Leibniz mere subjective determinations or thought-forms as they were to Kant. This, in spite of the idealistic and spiritualistic treatment, on the part of Leibnitz, of matter, extension, space, and time.

In the existential world, Leibniz treats of the knowledge of the ego, of God, and of the sense-world, and these require, I have maintained, from the real side, more than the recognition merely of the formal or logical side of the thought of Leibniz. For, taking the whole thought of Leibniz, inclusive of what the most recently edited texts reveal, the logical view and the ontological aspect of things are never entirely separated. Both must be taken, as I have

urged, to get a complete view of his system. This position is strengthened by reference to the texts of Prof. I. Jagodinsky, described and summarized by A. Rivaud.[12] In these, the thought of Leibniz is, in the highest degree, metaphysical or synthetic. The universe is to him a coherent whole, it embraces, in its harmonious character, the totality of the real. To exist is to enter into the harmony of the whole; it is to be harmonious, according to these texts. I may add that a feature of the system of Leibniz, due to its attempts at theodicy, is, that it is marked, in spite of all talk about its pluralism, by a certain monism—the monism of *order*. The unity of the world, as embodying God's purpose, is the strong contention of Leibniz, for his plurality without unity would mean chaos. The pre-established harmony implies one law, which binds all things together in orderly fashion. Leibniz became compelled, in the outworking of his monadistic system, to give up, in reality, the separateness of the monads, and to treat them as depending upon God, and as organized by Him into the unity of a coherent whole or cosmos. Only those monads, it finally turns out, are real, which are not in isolation, but co-exist as component elements in the world, wherein God's purpose is being realized. Lotze carried out more fully this interrelation of things and beings. This, however, Hegel, with his concept of reciprocity, had, in some respects, done before Lotze. But Leibniz, before either of them, had the merit to regard the universe as, in the last result, spirit, and, as such, One and Many. But these, as we have shown, he never reconciled or harmonized in a satisfactory way. It also remains a suggestive inheritance from Leibniz that every monad mirrors, potentially, the universe, and is big with the future. "For a monad," said Amiel, "which is the virtual universe, a whole infinite of time is not too much to develop the infinite within it."

[12] *Revue de Métaphysique et de Morale.* Jan., 1914.

II.

We now come to the views of Leibniz on Truth. In the mind of Leibniz, questions of the validity and of the rise of knowledge were not sufficiently discriminated, a fact still sometimes overlooked by his interpreters. Quite conformably with his time, he marks no real separation between these—that is, between criticism and psychology. On the formal side, or logical expression, of truth, we have the maintenance to which Leibniz attached so much importance;[18] the notion of the predicate is in some way contained in the notion of the subject. This is another way of saying what he otherwise expresses when he insists that the notion of each individual substance includes all its events and characteristics. Also, in the "New Essays" he insists that knowledge is nothing but the perception of the connection and fitness, or the opposition and unfitness, that one finds between two of one's ideas. A very Lockian definition of knowledge indeed. Leibniz also says, in the same work, that it is better to make truths consist in that agreement between the objects of ideas whereby one is included or not included in the other. The logico-grammatical expression of the truth is, for Leibniz, the judgment; in which he is at one with Aristotle, Aquinas, and Kant. The understanding, in his view, relates a representation to an object. Such power of representation belongs as essentially to the monad as does its striving, hence it cannot be without such representations. The consciousness content of a monad, however, grows out of itself, and is grounded in its own being or essence; it is not borrowed from the outside, but is self-created, on the Leibnizian view.

[18] Namely, *praedicatum inest subjecto.*

In this sense, all our knowledge is of an *à priori* character. This still leaves room for our distinguishing between aprioristic elements in this strict sense, as framed by the understanding, and those empirical elements, which arise from sense-perception. The connection of the notion of the subject with that of the predicate is supposed by Leibniz to be known by the understanding from the mere comparison of the ideas or thought-content. This means such an *à priori* judgment as that just spoken of—an eternal and necessary truth. These necessary truths are so called because they bear the characters of universality and necessity. But if the connection of the two has to be sustained on causal grounds—some sufficient ground or reason—we have an accidental or fact-truth, that is, an *à posteriori* judgment. Contingent truths, says Leibniz, are those which, without doing violence to reason, we may conceive to be otherwise. To say "Socrates was a philosopher" is to assert a proposition which is true, but need not have been so. But Leibniz holds there must be a sufficient reason for contingent truths. And the sufficient or final reason must be outside the serial detail of contingencies, however infinite it may be. Truth of fact, or contingent truth, is truth of experience or perception, and is gained by induction rather than through demonstration. Of such contingent truths, the principle is merely fitness or choice of the best. Necessary truths, on the other hand, depend neither upon instances, nor upon the evidence of the senses; they arise out of reason as absolutely necessary and universally valid, and their contrary would mean a logical contradition, and is therefore impossible. Such are reason-truths[14] or eternal truths. They include metaphysical insights, logical and mathematical truths, and moral laws. Human knowledge is perfected out of the two kinds or sets of truths already described, and rationalism and empiricism are both one-sided, so

[14] *Vérités de raison.*

long as either claims all knowledge as purely from the one or from the other. The Leibnizian distinction seeks to mediate between the two, whose differences are held to be grounded in the quality of reality itself. The necessary truths, resting, as in his view they do, upon the Divine understanding, are unconditional and valid for all worlds. Truth, for Leibniz, exists as a necessity, not outside, but within the Divine Mind.

The distinction of truths of reason and truths of fact, as two qualitatively different kinds of knowledge, has its root in the actually existing difference of the deductively and the inductively elaborated sciences. Identical propositions are the first or *à priori* truths of reason. The first *à posteriori* truths, or truths of fact, are found in the immediate apperception of our own existence, and of our own thoughts and experiences. It was a great merit in Leibniz to have so successfully devoted himself to exhibiting the character and vindicating the validity of the necessary and universal truths. For this task, his rationalism, apriorism, and mathematical genius, eminently fitted him. "The human mind," said Leibniz, "is not only capable of *know*ing universal, necessary truths, but of discovering them in itself. There is a disposition, an aptitude, a preformation, which determines our minds *to elicit* these truths, and causes that they *can* be elicited." Hence Sir William Hamilton credited Leibniz with "the first full and explicit announcement" of "one of the most momentous principles in philosophy." These eternal or necessary truths are, to him, truths of reason, which the understanding recognizes independently of experience and whose validity is independent of it.[15] They cannot in his view, be resolved into anything more simple, for you have come, by analysis, to what is primitive. In the case of these necessary truths, it is said from the idealistic side, that their objective validity

[15] *Ex solis principiis mentis insistis.*

arises from the nature of structure of spirit, and that the understanding is here creator of the object, originator of the laws. No doubt, something is to be said for this, from the psychological point of view. But, from the realistic side, it is contended that the human spirit merely recognizes these truths, but nowise creates them, and that they belong not merely to thought-order, but to the metaphysical order of being. Much can be said for this latter contention. That the necessary and eternal truths are laws of being, and not merely laws of thought, that is, are realized, in the nature of things, is seen from mathematical positions, as when we say, for example, that the whole is greater than the part. It must be remembered that the formal logic of Leibniz has its orientation in metaphysics, and that he sought to complete and improve his logic on the basis of mathematics. The transcendent objective validity of the eternal and necessary truths he sets on an ultimate ontological foundation. He holds that, corresponding to them is being, transcendent and independent of thought, in what he calls the inner possibility of things, the essence of things, in other words, the reality of the metaphysical order. It is in pursuance of this line of thought that we find Leibniz saying "the understanding of God is the region of eternal truths" and that "if there is a reality in essences or possibilities, or rather in eternal truths, this reality must needs be found in something existing and actual" to-wit, "in the existence of the necessary Being." "God," said Leibniz, "is the truth in us," for to him the idea of God was that which is most intimately one with the mind.

The contentions of Leibniz for eternal and necessary truths have lost none of their importance for our own time, wherein sundry attempts have been made to convert logic into a psychological discipline, and to reduce truth to the mere satisfaction of a need. But we must hold, with Leibniz, that eternal truths are valid without reference to the

the Hegelian "Logic" can give us. You are not at liberty to seek a monism in which no real justice is done to the mind's need of definiteness and distinction on the way to a final monism, if a monism be, as I think it is, possible. The monism reached must be a real one, not based on mere concepts, and not the result of repression of this need of the mind. Justice to distinction and difference need not bar the way to a final monism—unity and harmony, but it will secure that the monism is a real oneness with the ground of all being, not a mere thought—unity *in abstracto.*

We have now seen some of the virtues—the breadth and critical insight—of the system of Leibniz, and criticized some of its defects; it was a rationalism that deduced the world too much on *à priori* principles, and raised its constructions in far too great independence of experience. It imposed reason upon reality, instead of grounding reality in reason. Reason, apart from actuality, remains in abstraction. But the real is already rational, far beyond what appears in the system of Leibniz. And only by the rational can the rational be known. But the suggestiveness of that system is not to be denied, and its influence on subsequent philosophy has been far-reaching and fruitful. But a rationalistic philosophy has no need to stand to-day where stood Leibniz; it would be without excuse if it did. But a broad-minded and vital rationalism is still possible, and is for many of us the highest form of philosophy possible. Its fundamental maintenance is just the intelligibility of experience; it founds on experience, but it must be experience in the broadest possible sense, with no cramped, positivist cast about it. But this without neglect of, or injustice to, what the senses can give us. Its faith will still be in reason and its insights, as the highest world-interpreter we have. But it must be living reason, in closest alliance with living will and real feeling, not the rigid, abstract reason of many arid rationalisms of the past, and, as true and vital

rationalism, it must seek the clearest possible conceptions of all that is given to it in experience. Such rationalism refuses to be baffled by the problems of unity in diversity, the One and the Many, change and evolution, life and consciousness, freedom and responsibility, reality and value, purpose and cause, or any of the other vital problems that engage the philosophic mind.

JAMES LINDSAY

IRVINE, SCOTLAND.

EVOLUTION AND EPITOMIZATION.

I.

THE most significant characteristic of the sciences at the present time is the extent to which materialistic and mechanistic theories are elaborated and accepted. In saying this one need not ignore the situation in biology, where vitalism still exhibits some vigor; for it will be strange, after all, if the science of biology does not in its own development exhibit one of those mutations of which it speaks, and one of these days, with apparent suddenness, burst forth into a form which will at last give expression to its many latent and recessive mechanistic factors.

It is a problem for philosophy, concerned with the maintenance and development of abiding values, to know how to deal adequately with this trend of the sciences. In the past, it has been possible to depend upon a supposed duality of matter and spirit; but since the conception of spirit, especially in its teleological forms, is beset by difficulties, and since, according to the modern scientific view, no one can think of matter as threatening to prove ultimate, nor as being coarse, nor inert, nor degraded, one is led to suspect that men who never understood either matter or spirit jumped to the conclusion that they were opposites. Sometimes the views of Lotze and his successors are invoked to refute mechanism; but the day has gone by when anything which is admitted to be universal in extent can be dismissed as negligible in importance. Nowadays

mechanism secretes its forces in the wooden horse of psychology, and thereby penetrates the very citadel and sanctuary of values. Of course a concrete value, an actual experience of valuation, is different from an abstract theory about a value; but to fix a gulf between the two, and to declare the latter incapable of interpreting the former, means the appearance of still more troublesome questions about the status of one, or the other, or both. Is it not time that a philosophy which still recognizes the importance of the problem of a sanction for our great values should, instead of trying to undermine materialism and mechanism, or get round them, accept them and try out their constructive possibilities? Perhaps the presence of values and ideas in the midst of a mechanistic world process can be accounted for in a way which will give them added significance by reason of their essential relations to it.

In this paper an attempt will be made to indicate, in a preliminary and sometimes tentative way, some of the steps in the development of such a view. It is obvious that such a view must call for a correlation of the sciences. The correlations usually attempted are either abstract and general, or else fragmentary, or else dependent upon what seems to be an inadequate epistemology. The great example of an abstract and general correlation is the theory of evolution. Fragmentary correlations are found in such combinations as physical chemistry and physiological psychology. A correlation pivoting upon epistemology is attempted when it is said that the various sciences are so many abstractions in which the universe is studied from different points of view.

Of these correlations the most striking is that afforded by the general theory of evolution. Two broad criticisms may be brought against it. From the side of pluralism it may be said that perhaps, even when formulated most scientifically, the theory imparts a false simplicity to the world—the evolutionary process may be only one current in

the vast ocean of the universe. Another criticism comes from the side of philosophy of religion. If it be granted that philosophy of religion has a right to criticize in such matters, is it not significant that this most meaningful portion of philosophy has, after all, gained but little from this most prevalent and important of scientific concepts? From the questions suggested by Huxley's *Evolution and Ethics* to the attempts like that of Royce[1] to give evolution a ground in the Absolute, there seems to run a common motivation, to the effect that the theory of evolution, in one way or another, fails to measure up to the hopes or demands of religion. Only pragmatism and its kindred philosophies seem to hail the theory of evolution with anything resembling joy; and yet pragmatism, with all the data of evolution at its disposal, offers us adventure rather than assurance—forgetting that a process before which the doors of the future stand wide open can destroy its own treasures and devour its own children. There seems to be a need for the development of some line of thinking which, while agreeing with pluralism that we can at most analyze only a portion of the universe, and with pragmatism that absolute assurance is not possible, will, as against pluralism, treat the portion available for study as an organic whole, and, as against pragmatism, make clear, if possible, that there are certain principles which govern the process of evolution and prevent its wandering entirely afield.

The fragmentary correlations, noted above, are too familiar to need comment. The attempts to correlate the sciences by considering them as so many abstractions, so many partial views of the world process, taken from various angles and in accordance with different interests, bear witness to the basic fact that sciences do not develop without scientists, but fail after all to give due recognition to the

[1] *Cf.* J. Royce, *The Religious Aspect of Philosophy* (1885), pp. 238 ff, 460 ff.

overwhelming aspect of the universe, and to what we must suppose are the independent relations of its structures and processes. The vicissitudes of idealism ought to make it clear, if anything can, that the world is not a case of the knowing process, but that the knowing process is one of the interactions between some of the many structures—material, physiological and psychical—of which the world is composed.

Our proposition is, to study these structures and processes in detail, and thereby, while showing the partial nature of all the foregoing correlations of the sciences, to offer a basis for a new correlation. We shall include the knowing process, but regard it as a particular case of a wider group of interactions; and we shall use the data of evolution, but try to show that the process of evolution itself acquires new content and meaning when the data are exhibited as evidences of another process or group of processes which we call epitomizations.

Epitomization has three specific implications which we shall formulate in this paper. It may be defined in general as the occurrence, at the so-called later stages of evolution, of structures and processes which are essentially analogous to those occurring at the so-called earlier stages. Examples may be noted in the resemblances of atoms—if Rutherford's theories are to be accepted—and the solar system; or, of unicellular and multicellular organisms; or, according to some geologists, of an organism and the earth. By formulating the general definition as above, one avoids the question, unimportant for our purposes, whether the so-called earlier and later stages of evolution are correctly arranged, or whether, if a large enough portion of the universe is taken into consideration, all the structures and processes do not develop simultaneously. What is proposed is not so much a critique of the notion of evolution as a new analysis of the evidence which is cited as a basis of

the theory of evolution. The use of the words "essentially analogous," and the method which they imply, can best be defended after some of the data have been examined.

II.

The first of the three implications of the hypothesis of epitomization leads to a kind of realistic monadism. It is the most abstract of the three, although not altogether separable from the other two. It involves more intricate and detailed work than the others, and offers some of the chief difficulties in the way of the development of the general argument. It is not pretended that the investigations here are complete, nor at some points beyond the hypothetical stage; but it is suggested that here is a line of inquiry which, even at the cost of much correction and reformulation, may be expected to remain significant. It is granted that such a monadism can show only one, or at most only a few of the factors which are operative in the world; but it is urged that to disregard this monadism is to disregard the details of the world's structures and processes. It ought to be noted that we are dealing not, as in the case of the older monadisms, with purely speculative entities, but with things which are studied in laboratories and observatories.

The theory of evolution assumes that certain of the constituents of the world as we now know it correspond to, if they do not survive from, other constituents at earlier stages of its development, and that these stages can be arranged in one or more evolutionary series. For example, when it is found that material bodies as we know them are made up of atoms or electrons, it is inferred that independently existing atoms or electrons have, at earlier stages of evolution, antedated those material bodies. Let us call each such quasi-independent constituent of the world a monad, taking the term in a sense neither less nor more

definite than the term "individual"; and, without at present attempting to go far into the metaphysics involved, let us enumerate these monads as a step preliminary to that of indicating a schematic arrangement to which their analogous structures and processes can be reduced.

Beginnings in this case must be determined by the limitations of present-day scientific investigation. Without endeavoring to account for the origin of electrons, we may begin with (1) electrons in an electromagnetic field, where changes of velocity give rise to radiations. After these we may place the more or less familiar series—(2) atoms; (3) molecules; (4) masses of matter, including both the smaller and larger astronomical bodies; (5) our solar system and perhaps other solar systems; (6) larger units, more or less indeterminate, such as globular clusters,[2] our galaxy,[3] possibly some of the spiral nebulate,[4] and perhaps even one or more vast groups of spiral nebulae.[5] Bearing in mind that this is only a preliminary enumeration, and postponing many questions which arise concerning the relations of these monads, let us pass to another series, at least partially dependent upon the former. Here again it is hard to tell where the series begins, and any serial numbering of the monads must be open to question; but we may assume that some of the organic compounds of carbon are sufficiently distinguishable among chemical compounds, and sufficiently important in later developments, for us to consider them as monads. We may call these monads by the general term (..7?) "organic compounds." It is not difficult to find biologists willing to entertain, and even to develop somewhat, the assumption that some infra-cellular

[2] H. Shapley, "Star Clusters and the Structure of the Universe," II, *Scientia*, 26; 355 (1919).

[3] *Ibid.*, III, *Scientia*, 27; 100 (1919).

[4] A. C. D. Crommelin, "Are the Spiral Nebulae External Galaxies?" *Scientia*, 21; 365 ff. (1917).

[5] *Cf.* A. S. Eddington, art. "Nebula," *Encyc. Brit.* (11), Vol. 19, p. 333.

free living forms preceded the cells which we know;[6] but there is great diversity of terminology, and it is not clear what portions of the highly differentiated cells now known to us, if indeed any portions, may be supposed to correspond to the primitive free living forms. If persistence and definiteness of behavior of parts in the highly differentiated cells may be taken as indications of correspondence to certain free living primitive forms, some of these primitive forms may have been of the nature of microsomes[7] or chromatin granules;[8] but these subordinate units of the cells are themselves so complex from the point of view of organic chemistry[9] that it is hardly likely that the primitive forms which correspond to them represent merely the first stage of the synthesis of living matter. It seems better to regard them tentatively as (8?) later products, perhaps enzymic,[10] and quite likely corresponding to the chromatin of highly developed cells. Since in these cells both the genes[11] and the chromosomes[12] in which they are found are fairly well defined, it is quite possible that the term chromatin may include units of more than one degree of complexity.[13] The next two members of the series—(9?) unicellular organisms and (10?) multicellular organisms are evidently monads, within the meaning of the term. To think of the next member means to consider again the organismic theories of society;[14] but it accords with our

[6] E. B. Wilson, *The Cell in Development and Inheritance* (1896), pp. 21-22, and note.

[7] E. B. Wilson, *op. cit.*, p. 237.

[8] E. A. Minchin, "The Evolution of the Cell," in *Report of the British Association for the Advancement of Science*, 1915, pp. 437 ff.

[9] *Cf.* E. B. Wilson, *op. cit.*, p. 240.

[10] L. T. Troland, "The Chemical Origin and Regulation of Life," *Monist*, 24; 92 ff (1914); "Biological Enigmas and the Theory of Enzyme Action, *American Naturalist*, 51; 321 (1917).

[11] See T. H. Morgan, *The Physical Basis of Heredity* (1919), pp. 244-246.

[12] T. H. Morgan, *"The Mechanism of Mendelian Heredity* (1915), pp. 118 ff.

[13] *Cf.* Carl Snyder, "Life Without Oxygen," *Science Progress*, 6 (I); 134 (1911).

[14] For a survey of these theories see F. W. Coker, "Organismic Theories of the State, in *"Columbia University Studies in History, Economics and Public Law*, Vol. 38 (1910).

procedure to suppose that the next member, or more likely the several members which should next be considered, are (11 ?..) social groups of multicellular organisms—plants and animals—and symbiotic populations[16] of various degrees of complexity.

There remain some other entities which are not altogether different from some of the foregoing, and which are partially dependent upon them; these are best known to us in the nervous system. We are again confronted by difficulties in choosing the first members of the new series, but we may take them to be (..12?..) certain cells or groups of cells which become highly sensitive and specialized as effectors or receptors.[16] Along with these, and in combination with them, there appear in the course of development the nerve-cells and nerve-nets[17] which, together with their appropriate receptors and effectors, we shall call (13 ?) "nervous areas"—to consider the nerve-cells apart from their effectors and receptors is to reflect the procedure of the laboratory, not the course of evolution. As the next member of the series we take, for reasons which will be discussed below (14 ?), "simple,"[18] or "isolated"[19] reflex arcs, together with their appropriate receptors and effectors. Many of our nervous reactions are (15 ?) "complex reflexes," with appropriate receptors and effectors. All these enter into, or are differentiated within (16?..) the great complexes which constitute our emotional[20] and instinctive reactions, or—by the help of pur-

[15] A. J. Herbertson, "Discussion on Natural Regions of the World," in *Report of the British Association for the Advancement of Science, 1913*, p. 557.

[16] G. T. Ladd and R. S. Woodworth, *Elements of Physiological Psychology* (1911), pp. 16-17.

[17] *Ibid.*, pp. 17-18.

[18] C. S. Sherrington, *The Integrative Action of the Nervous System* (1906), p. 8.

[19] Ladd and Woodworth, *op. cit.*, p. 146.

[20] A. F. Shand, *The Foundations of Character* (1914), Chapter III.

posive ideas—our sentiments,[21] values, and "selves."[22]

The first implication of the hypothesis of epitomization is that if the series above enumerated be taken to represent even roughly the course of evolution, each monad, which marks a stage of evolution, exhibits structures and processes essentially analogous to those of the other monads. The course of evolution thus exhibits a series of epitomizations, in the first or monadistic sense of the term. That these characteristic structures and processes, which we shall now attempt to indicate, may recall sometimes the illustrations of Spencer's *First Principles* or the *a priori* methods of Hegel's *Naturphilosophie*, or numerous other relics of the past, is admitted, but held to be beside the point, which is whether the monads as defined exhibit the structures and processes or not.

Formulated briefly, the significant structures and processes may be said to be four—(I) *Individuation*, (II) *Interaction*, (III) *Reproduction*, (IV) *Integration*. Formulated in more detail, they include various subdivisions, as below. It may be noted that, although no hard and fast distinction is made, structures are emphasized in (I) and (IV), and processes in (II) and (III). Stated in more detail, the monadic formula is as follows:

> (I) *Individuation* of a monad, in (I-a) a milieu, which may include[23] [(I-a′) monads of stages previously developed, and] (I-a″) other independently arising monads of the given stage. This individuation is at most only relative, because of (II) *Interactions* of each monad with (II-a) the milieu [and (II-a′) monads of stages previously developed] and (II-a″) other monads of the same stage. With the inter-

[21] *Ibid.*, Chapter IV.

[22] W. B. Pillsbury, *The Essentials of Psychology* (1914), p. 352.

[23] Portions of the formula enclosed in brackets indicate structures and processes which appear at later stages of evolution rather than at earlier; if they occur at earlier stages they have not been detected.

actions are associated processes of (II-b) accretion or depletion [and (II-b′) internal, compensating interactions] sometimes involving (II-c) attraction or repulsion, which (II-c′) varies as new interactions ensue; [the result may be (II-d) disintegration of the monad, but sometimes, before this occurs, (III) *Reproduction* of another monad or monads from it] with (III-a) differences between monads which—especially after some of these monads of any stage, say n, have formed monads of stage $(n+1)$, as in (IV-b), below—may be summed up as relative differences between the terms of (III-b) a duality. [Some of these dualities may come to affect the processes of (III-b′) reproduction in a complex way.] Several of these individual monads may form (IV-a) *Aggregates,* within which they are (IV-a′) juxtaposed in space, or (IV-a″) succeed one another in time; or, several of the monads—sometimes those already within aggregates—may form (IV-b) *Integrates.* In both aggregates and integrates each constituent monad modifies all its structures and processes by reason of the presence of the other constituent monads; that is, both aggregates and integrates are marked to some degree by (IV-b′) interrelations of parts and (IV-b″) differentiations of structure. The integrates (IV-b) of any given stage of evolution, n, differ from the aggregates (IV-a) of that stage, in that in the integrates the modifications of the constituent monads are more marked, and in that the integrates (IV-b) of any stage n are the individuated monads (I) of the stage $(n+1)$.

Any monads of a stage n which are not thus integrated may appear, in connection with a stage $(n+1)$, as (I-a′) monads of stages previously developed. The interrelations of parts (IV-b′) and differentiations of

structure (IV-b″) of stage n are correlated, in the stage $(n+1)$, with the interactions (II) and reproductions (III), so that differentiations of structure (IV-b″) of the stage n appear in the stage $(n+1)$ as specializations of function.

[Sometimes new monads of the stage $(n+1)$ seem to arise not so much as the result of integrations (IV-b) of monads of the stage n, above described, but as the result of differentiations (IV-b″) of monads of some other stage, perhaps $(n+2)$. The fact seems to be that both processes are involved—that at some stages of evolution there is no integration of monads without concomitant differentiations of monads of other stages—and that in some cases of the production of new monads, the former process has (IV-c) been somewhat obscured by the latter.]

Before exhibiting the data for this monadistic scheme in such detail as will be possible within the limits of this paper, it may be noted that the scheme, although doubtless abstract enough, may, if taken as a description of the world, supply a metaphysics more concrete than that which deals with space, time, matter, motion, energy, cause, substance, and such concepts. The relations between this metaphysics and the other may be indicated by saying that the notion of substance arises when the milieu and its structures are conceived as uniformly as possible and that the other concepts noted arise when the interactions of various monads in the milieu are considered in one or another of their aspects at the expense of the rest. With a caution against carrying a comparison to detail before a more complete account has been finished, it may be noted that in the above formulation Process II has resemblances to Professor Sheldon's "productive quality,"[24] and Process

[24] W. M. Sheldon, *Strife of Systems and Productive Duality* (1918), Chapters XII and XIII.

IV to Professor Spaulding's "creative synthesis;"[25] and that a way is thus offered in which two principles prominent in contemporary metaphysics may be viewed within a consistent whole.

III.

Coming now to some of the details of the data, let us consider (1) electrons.[26] As was indicated above, they mark the limits of our present knowledge of those earlier stages of evolution through which the universe, or a significant portion of it, may be said to have passed. Nothing is known concerning the evolution of electrons from any previous stage, although there have been many conjectures. In any attempted description of electronic structures or processes the limits of knowledge are very evident. Since the electron is not material, many characteristic resemblances comparatively easy to detect in the cases of other monads must be modified if not given up. Results attained by means of mathematical formulae are often difficult to state in terms of a mechanical model; but there is general agreement that at least any electron may be said to exist in a medium (I-a)—whether the medium is spoken of as aether, or space, or by some other term.[27] The medium is to be regarded as containing a vast number of electrons (I-a″)—there is no indication at present that one electron gives rise to another. That electrons interact (II) with their medium (II-a) is assumed in theories which account for radiations as due to electronic accelerations, and regard radiant energy as motion of a medium.[28] Electrons inter-

[25] E. G. Spaulding, *The New Rationalism* (1918), pp. 448, 500.

[26] In this section the monads as enumerated above, are referred to by the Arabic numerals there tentatively assigned them; their structures and processes are referred to by the Roman numerals, with letters to indicate subdivisions, as found in the monadic formula.

[27] A. S. Eddington, letter in *Nature*, 107, 201 (1921).

[28] *Cf.* H. A. Lorentz, *Theory of Electrons* (1909), p. 52.

act with other electrons (II-a″). They do not grow, as a material body may be said to grow, and their charges, so far as is known, remain constant; but it may be said that with their interactions are associated certain accretions and depletions (II-b), in the sense that their velocities, energies, and sometimes their masses[29] may increase or decrease. The interactions of electrons with other electrons are marked by attractions and repulsions (II-c), which depend upon relative positions (II-c′). Each electron differs from every other, even if the difference be only one of position in space and time (III-a). In the atomic relationships of electrons, there is a duality of positive and negative charges (III-b). The fact that the medium must be regarded as containing a vast number of electrons is another way of saying that electrons may be associated as an aggregate (IV-a). They may also, according to accepted theories, be integrated with positive nuclei—the exact nature of which is at present a matter of debate—into atoms (IV-b), marked by interrelations of parts (IV-b′) and differentiations of structure (IV-b″); the chief differentiation is that into central and peripheral regions. These atoms form the individuated monads (I) of the next stage (2), the structures and processes of which are considered in the next paragraph. It should be noted that, according to the recent work of Rutherford,[30] there is much to be said for the view that the heavier atoms are not built up directly from electrons, but from atoms of hydrogen and helium; the monadic formula has a place for such a process, below.

(2) An atom (I) thus appears in its milieu, or medium (I-a), which may contain free electrons (I-a′) and other independently arising atoms (I-a″). That atoms interact with the medium (II-a) appears from the facts of absorp-

[29] J. J. Thomson, article "Matter," in *Encyc. Brit.* (11), Vol. 17, pp. 892-3.
[30] E. Rutherford and J. Chadwick, letter in *Nature*, 107, 41 (1921).

tion and radiation. That atoms take up and give off electrons is indicated by some of the facts of radioactivity and attendant processes; and that some atoms take up and give off other atoms (II-a″) may be inferred from the above-mentioned work of Rutherford. Such interactions involve appropriate accretions or depletions of the atoms (II-b), and, according to the theory of Bohr,[31] for example, internal and compensating interactions (II-b′)—readjustments of the constituent electrons among themselves. The accompanying chemical attractions and repulsions (II-c) vary as new interactions ensue (II-c′), for example in cases of auxiliary valencies[32] and saturation. These interactions may continue up to the point of disintegration of the atom (II-d), of which the most conspicuous known form is the expulsion of alpha-particles in radioactivity.[33] The atoms come to differ among themselves (III-a); the differences, especially apparent in atoms which make up molecules, may be summed up as differences between the terms of a duality, *i.e.*, electropositive and electronegative, or basic and acidic (III-b). This relation of duality among the atoms, considered in the order of increasing atomic numbers, is expressed by the periodic law. Atoms perhaps form aggregates (IV-a) in some of the nebulae which give line-spectra rather than band-spectra. Atoms form integrates which we call molecules, characterized by interrelations of parts (IV-b′) and differentiations of structure (IV-b″)—the chief differentiation being, again, that into central and peripheral regions. In some of the molecules, according to the octet theory,[34] the differentiation resembles that of an atom; but in the more complex molecules, at least in those

[31] N. Bohr, letter in *Nature*, 107, 104 (1921).

[32] See A. Werner, *New Ideas on Inorganic Chemistry*, transl. Hedley (1911), pp. 35, 68.

[33] See, *e. g.*, E. Rutherford, "Radiations from Exploding Atoms, *Nature*, 95, 494 (1915).

[34] I. Langmuir, "The Arrangement of Electrons in Atoms and Molecules, *Jour. Am. Chem. Soc.*, 41 (I), 934 (1919).

of organic chemistry, the constituent atoms belong more definitely to either central or peripheral regions. Certain inorganic, rather than organic molecules are the individuated monads (I) of the next stage (3), the structures and processes of which are considered in the next paragraph. Molecules often arise not so much as the result of integrations from atoms as of differentiations within such astronomical bodies as we shall consider later; the former process is somewhat obscured by the latter (IV-c), but in either case there are interrelations of parts and differentiations of structure.

(3) In order for a molecule to be an individuated monad (I) it is not necessary that the molecule should arise by a combination of atoms in "free space"; it may arise in an atomic aggregate. The assumption that molecules exist in interstellar or interplanetary space has been thought to account for the absorption of light in such regions.[35] The interactions (II) characteristic of molecular monads resemble those of the atoms. The physicist studies molecules in motion, and finds that they differ in velocities; any case of such difference presents a duality (III-b) of swifter and slower molecules. In conditions like those of a vacuum tube, velocities help to determine the results of collisions between molecules,[36] with the dislodging of atoms or ions which may form the basis of new molecules (III-b'). Molecules may be aggregated into nebulous masses, or—perhaps within these—integrated into other astronomical bodies (IV-b), which exhibit interrelations of parts (IV-b') and differentiations of structure (IV-b''). These astronomical bodies may be minute or vast—composed of relatively few molecules, like a meteorite, or a huge assemblage, as in the case of a nebula, star, planet, or satellite; these astro-

[35] *Cf.* the theory of "cosmic dust"—S. Arrhenius, *Worlds in the Making*, transl. Borns (1908), p. 108.

[36] *Cf.* J. J. Thomson, *Rays of Positive Electricity* (1913), pp. 52-53.

nomical bodies form the individuated monads (I) of the next stage (4). It is evident that many of these astronomical bodies must be said to arise not so much as the result of integrations of molecules, but as the result of differentiations within still larger units,[37] such as nebulae or solar systems; the former process is somewhat obscured by the latter (IV-c).

(4) Omitting much of the complicated detail concerning the structures and processes of the other astronomical bodies, let us consider briefly those of the earth, which presents a complicated case of the operation of the same general principles. According to the widely accepted planetesimal theory, the earth is one of the results of a series of disturbances produced in its parent body by a passing star.[38] The earth was at first a "planetary knot"[39] (I) in the medium (I-a) which contained free molecules, atoms and electrons, with all the interactions which we have considered (I-a'), as well as other planetesimals (I-a").[40] The planetary knot interacted with all these (II-a, -a', -a"), and grew by accretion[41] (II-b). At least in some knots[42] there was also depletion, for the lighter gases were radiated away. The earth's internal and compensating interactions (II-b') include its rotation, magnetism, rock-flow, circulation of waters, atmospheric currents, stratification, weathering, volcanic eruptions, earthquakes—in short, the structures and processes studied in geology and its allied sciences. All these processes are accompanied by what is usually known as gravitational attraction (II-c), which varies according to the mass and distance (II-c'). It is conceivable that the earth's inter-

[37] T. C. Chamberlin, *The Origin of the Earth* (1916), p. 133.
[38] T. C. Chamberlin, *Ibid.*, pp. 130, 135.
[39] *Ibid.*, p. 132.
[40] *Ibid.*, p. 141.
[41] *Ibid.*, pp. 132, 138.
[42] *Ibid.*, p. 138.

actions as outlined may lead to its disintegration (II-d), perhaps as the result of a collision with some other astronomical body, or of loss of energy and consequent falling into the sun. According to some of the older theories, the earth "threw off" its satellite (III); later theories, as noted above, are inclined to the view that such processes are found only in the parent nebula or sun, where, either with or without the agency of a passing star or other body (III-b'), a process of reproduction of one astronomical body from another or others is thought to have taken place. The individual variations between astronomical bodies tend to be obscured in the case of the earth and other planets, because of the fact that they are more or less coördinated as members of the solar system. Between stars, the individual variations (III-a) may be summed up as those between older and younger, or dwarf and giant,[43] or slower and swifter[44] stars; and we may suppose that the differences between planets[45] are remotely comparable to these. A clear case of integration (IV-b) of astronomical bodies into solar systems would require that central bodies "capture"[46] their satellites, spacing them out in such a way as to result in interrelations of parts (IV-b'), and differentiations of structure (IV-b")—the chief differentiation, again, being that between central and peripheral portions. It is more in accord with accepted theories to say that solar systems arise not so much as the result of integrations of astronomical bodies, but as the result of differentiations within a vast parent nebula. The fact may be that both processes are in operation, with the former somewhat obscured by the latter (IV-c).

[43] H. N. Russell, "Relations Between the Spectra and Other Characteristics of the Stars, *Nature*, 93, 253, 283 (1914).

[44] *Cf. Ibid.*, p. 286.

[45] See T. C. Chamberlin, *op. cit.*, p. 141.

[46] A. C. D. Crommelin has criticized the capture theory in *Scientia*, 17, 1 ff. (1915).

For (5) solar systems, and (6...) larger units such as clusters, galaxies, spiral nebulae, etc., the formula appears to fit so far as researches have been made; but the small amount of available data, and the possibility of varying interpretations make definite statements difficult. It may be noted that the physical and astronomical effects[47] which are now regarded as tending to confirm the Einstein theories may be taken as instances of internal and compensating interactions (II-b) within the solar system, or within one or another of the larger units—perhaps within the finite universe itself as the largest and the all-inclusive monad.

(..7?—11?..) That a formula providing for individuations, interactions with accretions and depletions, disintegrations, reproductions, integrations and differentiations of structure would apply in general to the biological monads is evident, although the manifold details of these applications require more attention than can be given them in this paper. One should note the importance, throughout the biological series, of the milieu (I-a), which now includes not merely the medium which serves as milieu for the stages preceding the biological, but also includes all those stages, and constitutes the 'inorganic environment." Each biological monad interacts with the inorganic environment (II-a), and with the biological monads of stages previously developed (II-a'), and with other monads of the same stage (II-a"); when these are reviewed in detail any given organism is described in its vital relations with the environment, other species, and other individuals of its own species. In the higher organisms the processes involved in internal and compensating interactions (II-b'), *e.g.*, periodicities of food-taking, breathing, rest, etc.; alternations of heightened and depressed vitality; growth; diges-

[47] For a discussion of the evidence see W. H. Pickering, "The Einstein Theories," *Scientific American Monthly*, 3, 292 ff. (1921).

tive, assimilative, circulatory, excretory and muscular systems—in short, the processes studied in physiology—present detailed complications of some difficulty. The terms "attraction" and "repulsion" (II-c) may be applied at least to the chemical processes in positive and negative tropisms;[48] it must be expected that some questions will be raised if these terms are extended to include the physiological conditions of appetite, etc., which accompany the appropriation or rejection of food, although such an extension is in line with mechanistic conceptions. Individual variations (III-a) may be summed up as differences between the terms of various dualities (III-b)—older and younger, active and inactive, well-nourished and poorly-nourished—all associated with differences of katabolism and anabolism which, according to a famous theory,[49] is the chief factor in the differentiation of sex (III-b′) in (10?) multicellular organisms. The aggregation (IV-a) or integration (IV-b) of individuals may give rise to (11?) social groups, marked by interrelations of parts (IV-b′) and differentiations of social structure (IV-b″). Groups contain both plants and animals. Among the animal members, a differentiation almost universal is that between leaders and followers. Sometimes social groups seem to arise not by integration of individuals—which suggests the old contract theory of society—but by differentiations within a larger and more indefinite group. The fact is that both processes are in operation, and that the former is obscured by the latter (IV-c). The inclusion of (11?..) social groups within the biological series means, as was indicated, a certain amount of recognition of the organismic theory of society, which is commonly held to have been discredited.[50] The point here, however, is not whether a

[48] See J. Loeb, *The Dynamics of Living Matter* (1906), p. 138 f.
[49] P. Geddes and J. A. Thomson, *The Evolution of Sex* (1914), Chap. X.
[50] For a criticism of the theory see F. W. Coker, *op. cit.*

social group is an organism, but whether a social group is a monad; and it can hardly be doubted that social groups do exhibit the various processes indicated in the monadic formula. The trouble with the organismic theory of society was not so much in the facts which it cited, even though it was guilty of extravagances; the chief trouble was in the facts that it did not cite. It left little room for the individual personality, and failed to take account of the immensely important psychological factors which everyone must recognize as operative. In short, the organismic theory was an abstraction. Let us not forget that the monadic formula is also an abstraction; all that is here contended is that the monadic formula offers the kind of abstraction with which the organismic theory agrees, and in connection with which the organismic theory can be estimated on the basis of the qualified and partial truth which it contains. Larger societies are often differentiated (IV-b″) into what may be called conservative and progressive groups, although these terms usually imply the intervention of developed values and ideas.

There are several reasons why it is not very apparent that the monadic formula applies in neurology and psychology. The first of these reasons is that the grounds for the distinction between neurology and psychology are often mistaken. The distinction, for us, is not that between the two members of a psycho-physical parallelism, nor between the two factors of an "interaction," but between a series of structures and a series of processes, essentially inseparable, for both of which the monadic formula aims to make provision. That which, from the point of view of integrations (IV-b) and differentiations (IV-b″) of the monads of any stage n, is a structure, is from the point of view of interactions (II), especially internal and compensating interactions (II-b′), of the monads of stage $(n+1)$ a process. In other words, individuation is a matter of

process as well as of structure. "Neurology" is a term which covers a series of structures; "psychology" is a term which covers a series of processes—and the two are essentially inseparable. From this point of view, the distinction sometimes made between structural and functional psychology[51] might well be modified. Since neurology and psychology are for us essentially inseparable, we adopt the term "neuropsychology." The second reason for confusion with regard to the application of the monadic formula is allied with the foregoing; it is our heritage from the long debate about epistemology. According to the monadic formula, the whole epistemological problem may be considered as a special case of interaction of monads of any given stage with monads developed at previous stages (II-a′) or at the same stage (II-a″) of evolution. In general, the process of interaction (II) is cumulative from stage to stage and from series to series. When the monads which interact belong to the series numbered from (1) to (6 ?. .), the interactions are confined, as we saw, to various physical, chemical, or astronomical accretions and depletions. The monads which belong to the series numbered from (. .7 ?) to (11 ?. .) are never out of interaction with the foregoing series—biological organisms are acted upon, for example, by radiant energies, masses of matter, gravitational forces, just as if the organisms were part and parcel of the infra-organic world. But the organisms exhibit, in addition, more complicated structures and processes of their own, for example in the ingestion and assimilation of food and the excretion of waste. The fact that these biological processes are more complicated does not mean, however, that they are out of place in the world, or cannot be accounted for in the regular course of evolution. Once more, the monads which belong to the series num-

[51] *Cf.* G. A. Coe, *The Psychology of Religion* (1916), p. 17; E. S. Ames, *The Psychology of Religious Experience* (1910), pp. 18, 19.

bered from (..12?) to (16?..) are never out of interaction with the monads of either of the two series preceding—nerve substance exhibits physiological, as well as chemical and physical interactions. But, again, nerve substance also exhibits, in addition, more complicated structures and processes of its own, which many writers, abstracting processes from structures, are content to call psychological, or psychical, and make very formidable under such names as consciousness, experience, and knowledge. But, according to the view here put forward, our experience and knowledge of the world is to be regarded as a comparatively recent and very highly complicated case of certain interactions found throughout the whole course of evolution. The fact that our sense-organs, nervous systems and muscles interact characteristically with the environment might be expected from the fact that all monads developed in the course of evolution tend to interact with monads previously developed. The "epistemological problem" is not one which has anything to do with the possibility of knowledge, for the phrase "possibility of knowledge" contains a fundamental contradiction in terms. The problem of epistemology has to do with a series of structures and processes which should be treated as descriptively as those met with in the problem of digestion. "Knowledge is natural." A third reason for confusion with regard to the application of the monadic formula to neuropsychology is that the processes of biological reproduction, especially of embryology, exercise important effects upon the development of nervous systems in all the higher species. For one thing, the course of development of nervous structures must be studied where they can be found, scattered throughout a myriad of individual organisms of different species, and subject to all manner of local conditions. Again, in the case of any one individual, the nervous system develops in the embryo by a process of

differentiation which, even more than in other cases noted, obscures (IV-c) the process of integration. But we hold that these facts do not rob the monadic formula of its significance for neuropsychology; it is recognized throughout our argument that the monadic formula is an abstraction, and does not account for all the relations which we find in the actual, concrete world. Some of these relations, as we shall see later, appear not in conection with the monadic formula but with the other two implications of our principle of epitomization; and with these the facts of neuropsychology acquire a new significance. A fourth reason for confusion seems most formidable of all; it might be called the argument from the egocentric advantage—*i.e.*, that we feel, or experience, or know ourselves to be essentially different from the world about us, the world which we analyze and construct into monadic or other formulas. As a corollary of this we find the view that the fact that we have values, purposes, and ideals sets our personalities apart from the structures and processes of the world around us. This fourth point can best be treated a little later, after we have examined some of the monads of the neuropsychological series in accordance with the formula.

(..12 ?..) The first members of the new series are hardly distinguishable from those of the series preceding; they are (I) the cells which, lying usually on the outer surface of an animal's body, become highly specialized, or sensitive to specific stimuli.[52] They appear in the midst of a milieu (I-a), which at this stage of evolution has come to include the "medium" of the physical and astronomical monads, the "inorganic environment" of the biological monads, and the *"milieu interne,"* or internal medium[53] of the organism. There may also be other independently arising sensitive cells (I-a″). Sensitive cells interact with this milieu

[52] Ladd and Woodworth, *op. cit.*, p. 16.

[53] Sherrington, *op cit.*, p. 4.

(II-a) and its monads previously developed (II-a'), and also, indirectly, in the absence of nervous conduction, with other sensitive cells (II-a''). That each interaction of these cells involves accretion or depletion (II-b), internal and compensating interactions (II-b'), attractions and repulsions (II-c) and their variations (II-c') follows from general considerations of cell chemistry, which are not altered by the fact that the interactions of these specialized cells are specific. Sensitive cells may proliferate (III) during the growth of the organism or the regeneration of lost parts. They come, especially after the appearance of nerve cells, to be distinguished as (III-b) receptors and effectors; and perhaps, in the lower animals, the development of the latter keeps rather ahead of that of the former[54] (III-b'). Sensitive cells may be aggregated (IV-a) into sensitive areas which develop at various parts of the organism; or they may be integrated (IV-b) with one or more[55] nerve cells into what may, for the lack of a better term, be called "nervous areas." The process of integration is obscured (IV-c), if not supplanted—especially in the embryos of higher organisms[56]—by a differentiation among the cells already present. In any case, the nervous areas exhibit interrelations of parts (IV-b')—marked by the appearance of fibrils[57]—and differentiations of structure (IV-b''). The chief differentiation is that into central (conducting) and peripheral (receptor and effector) regions. These nervous areas form the individuated monads (I) of the next stage (13 ?).

(13 ?) According to most authorities the nerve-cell or neuron, rather than its fibrils, is the fundamental unit of the nervous system.[58] It is not quite accurate, however, to

[54] Ladd and Woodworth, *op. cit.*, pp. 16-17.
[55] *Ibid.*, pp. 17 ff. *Cf.* Sherrington, op. cit., p. 309, and note [62] on following page.
[56] *Cf.* Ladd and Woodworth, *op. cit.*, pp. 38, ff.
[57] *Ibid.*, pp. 18, 40-41.
[58] *Ibid.*, pp. 113-114.

consider the nerve-cell by itself as an individuated monad; for, from the coelenterates[59] to the human embryo[60] the nerve cells appear only between or in the midst of other cells with which they function.[61] Accordingly, we take as the individuated monad (I), the "nervous area"—one or more nerve-cells with appropriate receptors and effectors. Such a nervous area, in which there is only one nerve-cell, is sometimes called an "arc," although it is important to note that the use of the term arc varies.[62] Nervous areas containing more than one nerve-cell are found when any part[63] of the nerve-net of a coelenterate, for example, is activated; but individuality is a matter of process as well as of structure, and the term nervous area should not be applied to the whole nerve-net except when this functions as a whole. The essential mark of the nervous area, as distinguished from later individuated monads, is that its conduction is indiscriminate and reversible.[64] Such nervous areas (I) arise in the midst of a milieu (I-a)—*i.e.*, they appear in the internal medium of the organism, which is in the midst of the environment, which, in turn, is in the physical and astronomical medium. Since the nervous areas are groups of cells, including sensitive cells, they may be expected to exhibit interactions (II) which are in general like those of any group of cells; especially important are their interactions with the milieu (II-a). That these interactions are accompanied by depletion, if not accretion (II-b) may be inferred from the fact that nerves under stimulation give off carbon dioxide.[65] The internal and

[59] *Ibid.*, pp. 17-18.
[60] *Ibid.*, pp. 38-41.
[61] *Cf.* Sherrington, *op. cit.*, p. 7.
[62] Sherrington (*ibid.*, p. 309) speaks of a case where "the conductor mediating between receptor and effector is itself *a separate cell* intercalated between a receptive cell and an effector cell" as "the simplest *arc* in the organisms which possss a true nervous system." But (*ibid.*, p. 7) he says "the conductor consists, in the reactions which we have to study, of at least *two* nerve-cells,—one connected with the receptor, the other with the effector." (Italics ours.)
[63] Ladd and Woodworth, *op. cit.*, p. 19, first complete paragraph.
[64] *Ibid.*, pp. 19-20; *cf.* Sherrington, *op. cit.*, p. 14.
[65] S. Tashiro, *A Chemical Sign of Life* (1917).

compensating interactions (II-b′) of these nervous areas constitute the process of nervous conduction, which, as we noted, is at this stage indiscriminate and reversible; it is also found that the action of a nerve-net does not differ essentially from that of one of its constituent parts, experimentally isolated.[66] At least in so far as the interactions of these nervous areas are chemical they may be said to involve attractions and repulsions (II-c); variations (II-c′) are apparent, for example in fatigue. The most general difference between nervous areas would appear to be that between the directions of their action, according as these are (III-b) inward or outward—the prototype of the differentiation into sensory and motor. Nervous areas may possibly form aggregates (IV-a) in organisms possessing "diffuse systems";[67] they may possibly be integrated (IV-b) in organisms which, as in flatworms and mollusks,[68] exhibit the beginnings of centralized nervous activity—but in all these cases one must keep in mind that differentiation (IV-c) is more apparent than integration. At any rate, when one compares annelids, arthropods, and vertebrates, there is evidently an increasing tendency for the nerve-cells not to anastosmose as readily as in the nervous areas; in the later species the fibres often run side by side in bundles called nerves, but each maintains its individuality; and the fibrils, at least in vertebrates, apparently do not connect the cells as in a primitive nerve-net, but end in proximity to neighboring cells—there is contiguity rather than continuity. But, in spite of all this, the annelids, arthropods and vertebrates exhibit a type of nervous conduction which is less and less diffuse and indiscriminate than that of the coelenterates with their nerve-nets, or that of the flatworms and mollusks with their partially modified nests.[69] Judging from the definiteness of the

[66] Ladd and Woodworth, *op. cit.*, pp. 18-19.
[67] Sherrington, *op. cit.*, p. 311.
[68] Ladd and Woodworth, *op. cit.*, p. 20.
[69] Ladd and Woodworth, *op. cit.*, pp. 20-22.

process, one would say that in the more highly centralized systems a new type of individuated unit must appear—a type which structurally is in general distinguishable from the fact that it possesses two or more nervous cells whose fibres often run in bundles and whose fibrils sometimes do not unite but form connections across near boundaries. These are essential points in the structure of a reflex-arc,[70] when the term is used in the sense indicated above. Possibly, then, reflex-arcs are sometimes the products of the integration (IV-b) of nervous areas—the fact that nerve fibres so often run in bundles may indicate that each nerve-cell tends at least to maintain its primitive connections with motor and sensory cells or groups of cells, and that nervous areas are still partially traceable in reflex-arcs, although central nerve cells have now been substituted for either effector- or receptor-cells, so that, instead of running directly from receptor through conductor to effector, the impulses now run from receptor through conductor to a central nerve-cell, then from this or some other central nerve-cell to a conductor, and then to an effector.[71] One might perhaps say that central cells serve as effectors for one type of nervous area, *i.e.*, the sensory, and also as receptors for another type, *i.e.*, the motor; something like this seems traceable in certain deliberate combinations of responses with stimuli. But in the formation of reflex-arcs, processes of differentiation within the whole nervous system obscure (IV-c), if they do not supplant, such processes of integration. In any case, reflex arcs exhibit interrelations of parts (IV-b)—evident, for example, in the synopses[72]—and differentiations of structure (IV-b′). The chief differentiation, again, is that into central, or coördinating, and peripheral, or receptor-, effector- and con-

[70] *Cf.* Sherrington, *op. cit.*, pp. 15, ff.

[71] *Cf.* Ladd and Woodworth, *op. cit.*, p. 21.

[72] Sherrington, *op. cit.*, pp. 16-18.

ducting cells. It is customary in dealing with them to speak in terms of process rather than of structure, and use the term "reflex." Reflexes serve to coördinate the activities of the organism, and also are themselves sometimes coördinated. The first grade of coördination is exhibited by the simple reflex, which we take as the individuated monad (I) of the next stage (14 ?).

(14 ?) The simple reflex is, according to Sherrington, "probably a purely abstract conception;"[73] Ladd and Woodworth suggest that a better term would be "isolated reflex," and that the essential point is not that the movement evoked shall be free from complexity, but that it shall run its course uncomplicated by other reactions occurring at the same time[74]—but they agree with Sherrington that probably no part of the nervous system is capable of reaction without affecting and being affected by various other parts.[75] The monadic formula is quite in accord with this, for it considers the simple reflex as possessing only a relative individuation (I) in the midst of the environment and the organism (I-a), and also whatever other reflexes may be operating within a nervous system in relative independence (I-a″). The interactions (II) of such reflexes do not differ in principle from those indicated in the case of nervous areas, although reflex conduction is usually irreversible and has other peculiarities.[76] Reflexes evidently interact with other reflexes (II-a″) in processes of "reinforcement"[77] and "spread."[78] The process of conduction itself may be regarded as an internal and compensating reaction (II-b′) within the reflex—for, whatever be the intimate nature of the process of conduction, some sort

[73] *Ibid.*, p. 8.
[74] Ladd and Woodworth, *op. cit.*, pp. 146-147.
[75] Sherrington, *op. cit.*, pp. 8, 114-115.
[76] *Ibid.*, p. 14.
[77] *Cf. Ibid.*, p. 175.
[78] Ladd and Woodworth, *op. cit.*, p. 169.

of commotion[79] is evidently relayed from one portion of the structure to another. Interactions may continue up to the point of discharge (II-d) of the reflex; discharge does not mean the disintegration of the substance of the nerve-cells, beyond the possibility of their incorporation in succeeding reflexes, but means that the process of coördination is completed, so that energy from the receptors is at length released into the effectors, and also that the nerve-cells which have figured in the transmission are now available for incorporation into new reflexes, through the breaking up of old synaptic connections and the establishment of new connections. This latter feature is evident in the "principle of the common path."[80] Perhaps one reflex may help to give rise to or determine the course of another (III) through certain residual effects, like the lowering of a threshold[81] in a portion of its arcs. Variations between reflexes may be summed up (III-b) in any of the terms which serve to describe antagonistic reflexes[82] and those involved in processes of inhibition;[83] for one of the fundamental characteristics of nervous conduction is that one reflex is functioning in more or less opposition to other reflexes. Several simple reflexes may constitute aggregates (IV-a) juxtaposed in space, or succeeding one another in time; or, they may constitute integrates (IV-b), characterized by interrelations of parts (IV-b′) and differentiations of structure (IV-b″). It is necessary here to make some distinctions. The general term covering both aggregation and integration of reflexes, as well as interactions (I-a″) of the reinforcing or spreading type, is "combination of reflexes," and the resultant reflexes are sometimes called "compound reflexes."[84] The distinctions

[79] *Ibid.*, p. 281.
[80] Sherrington, *op. cit.*, pp. 115 ff. 144.
[81] *Cf. Ibid.*, p. 184.
[82] *Ibid.*, pp. 135 ff.
[83] *Ibid.*, pp. 83, ff.
[84] *Ibid.*, Lectures V and VI, titles.

are, indeed, only relative; but this is also the case in connection with the other monads. We should say then that when a reflex spreads, but the result remains recognizable as merely a modified form of the original reflex, we have a case of interaction (II-a", above). When reflexes exhibit simultaneous or successive combination, in which the constituent reflexes remain well-defined, we have a case of aggregation (IV-a). When there is a combination in which none of the constituent reflexes are so well defined, but are rather fused in a larger unified reaction, we have an integration (IV-b). To these integrates we shall apply the term "complex reflexes"[85]—they are the individuated monads (I) of the next stage (15 ?). As in other cases, we must keep in mind that they may develop within the nervous system by differentiation (IV-c) more conspicuously than by integration; but in any case they are marked by interrelations of parts and differentiations of structure. The chief differentiations are, again, into central portions—especially the various tracts and regions of the brain, which become more complex as higher species develop—and peripheral portions—the increasingly complex mechanisms of receptors, effectors, and afferent and efferent nerves.

(15 ?) The complex reflex, in the general outline of its structures and processes resembles the simple reflex—so much, in fact, that we tend to describe our complex reflexes by over-simplifying them. Reflection shows that almost any act of one of the higher organisms, especially of man, involves coördination of a variety of nervous impulses coming from many different receptors and proceeding toward many different effectors. The complex reflex (I) has the same general relation to environment and organism (I-a), to previously developed nervous areas, *e.g.*, a local "diffuse system,"[86] (I-a'), and to other reflexes

[85] Sherrington uses this term on p. 143.
[86] *Ibid.*, p. 312.

(I-a″), as is found in the simple reflexes. That a complex reflex interacts with the organism (II-a) appears from various facts in connection with emotions;[87]; that it interacts with local diffuse systems (II-a′), from the innervation of viscera, heart, and blood-vessels; that it interacts with other reflexes (II-a″), from the differences between perception and sensation.[88] Perhaps some instances of "compensatory reflexes"[89] may be regarded as internal and compensating interactions (II-b′) within complex reflexes. The terms attraction and repulsion (II-c) are not often applied to the operation of these reflexes, although such an application would be justified in connection with electrochemical theories of nervous action. Variations in intensity (II-c′) play a prominent part in the reactions.[90] The discharge and subsequent breaking up (II-d) of a complex reflex does not differ in principle from that of a simple reflex. One reflex may help to give rise to another (III) through "association by similarity"—a small surviving portion may surround itself with new associates.[91] Differences between complex reflexes may be summed up (III-b) in any of the terms used to indicate antagonistic or inhibitory reflexes; a duality practically always found is that between tonic, or postural reflexes and clonic reflexes, or those which introduce a sharper and more definite reaction.[92] This distinction is allied with the distinction between familiar and new elements of experience, important (III-b′) in all cases of association. Several complex reflexes may by aggregation (IV-a)—mere juxtaposition in space or time—form habitual or instinctive complexes;[93] or, by integration (IV-b) form complexes which exhibit

[87] Ladd and Woodworth, *op. cit.*, pp. 523-524.
[88] *Cf.* William James, *Principles of Psychology* (1890), Vol. II, p. 3.
[89] *Cf.* Sherrington, *op. cit.*, p. 203.
[90] *Ibid.*, p. 231.
[91] James, *op. cit.*, Vol. I, p. 578.
[92] *Cf. Sherrington*, op. cit., pp. 231, 65.
[93] *Cf.* Ladd and Woodworth, *op. cit.*, p. 146.

more marked interrelations of parts (IV-b′) and differentiations of structure (IV-b″). To this class of complexes belong the more highly developed instincts and emotions,[94] and, in man, the sentiments,[95] values, and "selves;" these probably represent more than one stage of evolution. Such complexes may develop by differentiation (IV-c) within the organism and nervous system, as well as by integration. The chief differentiations within a complex are perhaps those between interoceptive and proprioceptive components,[96] on the one hand—including the structures of the "sympathetic system"—and, on the other hand, the exteroceptive components, proceeding from the environment, particularly through the distance receptors. In complexes involving the action of distance receptors a prominent differentiation is that into "consummatory reactions" and "precurrent reactions;"[97] this differentiation probably furnishes a prototype of consciously purposive action—the object seen, for example, at a distance, having the function later exercised by a perceived or conceived "end," and the precurrent reactions having the functions later exercised by the various means to an end.[98] According to this view, purpose is a case of organicity; according to the traditional view, organicity is a case of purpose.

(16?) The structures and processes of complexes must be considered briefly. That emotions, sentiments and values accord in general with the monadic formula is fairly evident, although their relationships are very complex. They are each distinguished more or less definitely (I) in the midst of the apperception mass (I-a′, I-a″). They interact with the environment and the organism (II-a), with single reflexes (II-a′), and with other complexes (II-a″)—the last point being evident, for example,

[94] *Cf.* W. McDougall, *Introduction to Social Psychology* (1915), p. 29.
[95] *Ibid.*, p. 125.
[96] *Cf.* Sherrington, *op. cit.*, pp. 129, ff. 317.
[97] *Ibid.*, p. 329.
[98] *Cf. Ibid.*, pp. 326, 330; also E. Rignano, "Attention," *Monist*, 22, 4 ff. (1912).

in the incorporation of emotions into sentiments,[99] or of values into new values.[100] The various complexes are changed by the addition or elimination of certain factors (II-b), as well as by changes going on within their own organizations (II-b′). There are marked differences of intensity (II-c). Complexes may be dissolved (II-d), or may give rise by association to new complexes (III), with variations (III-a) which may be summed up in any of the terms (III-b) expressing the fact that complexes contend for possession of the motor centres. Several complexes may exhibit even higher integrations (IV-b) into the great complexes known as selves—or possibly into certain ideal unities worthy of the name of personalities.

The last statement anticipates some very important points in the argument of this paper; for we have as yet treated values only in a very general way, and we have said practically nothing of language or ideas. Until these things which are so intimately involved in our actual experience are more adequately treated, the monadic formula must seem exceedingly abstract. It is our conviction, however, that these matters can be treated in accordance with the monadic formula, and that both our abstract theories and our concrete experience may profit by the treatment. This treatment may be summed up in six propositions, as below. The first three propositions I have treated in some detail elsewhere,[101] and hence shall merely state here.

1. Language, in the form of cries, arises among the individuals of an animal group as a result of conflicts of tendencies within their complexes. 2. Language develops sounds corresponding to the various parts of speech, and employed in articulated sentences, in proportion as the

[99] Shand, *op. cit.*, p. 62.

[100] *Cf.* Coe, *op. cit.*, p. 222.

[101] In Section I of an article entitled "The Implicit Duality of Thinking," which will soon appear in the *Journal of Philosophy*.

actions indicated grow more elaborate, and in proportion as speakers and listeners are more and more separated from the objects and actions indicated. 3. Language reactions are, according to some theories, the essential factor in thinking; but other theories trace thinking to perceptual images, or to conflicts of motor tendencies. In any case, thinking develops by the aid of processes of abstraction, generalization, and the metaphorical use of terms.

4. The fourth proposition is that an idea is essentially a complex reflex. To call an idea a simple reflex would be to espouse one or another of the theories mentioned in 3, above, or each of them separately; but to call an idea a complex reflex does justice to the fact that an idea apparently draws both form and content from language reactions, from perceptions, and from motor tendencies all at the same time. Moreover, an idea, like any complex reflex, follows the monadic formula. In a later paper I shall try to indicate in detail that an idea, in its characteristic formulation as a logical judgment exhibits a relative individuation (I), which in logic is called identity; that a typical case of interactions (II) is afforded by predication; that a process of accretion and depletion (II-b) can be traced in affirmation and negation, respectively; that the general process of reproduction (III) appears at this stage in the process of logical inference, especially in the syllogism with its conclusion formed from the interaction of two reflexes, one of which contains somewhat familiar, and the other of which contains somewhat new elements (III-b′)—in other words, the interaction of universal and particular premises; and that judgments, together with other elements of experience, may be integrated into values (IV-b), or that values may appear as differentiations (IV-c) within a more inclusive and indefinite apperception mass. In other words, one may, I think, profitably go

farther than Bosanquet[102] and some other logicians go in the direction of a "biologizing" of logic. I hope at some future time also to develop the view that the monadic formula can be applied to some at least of the fundamental concepts of mathematics. If all this is true, it indicates that the monadic formula exhibits the structure and processes of thinking. At this point one must beware of subjectivism; for it may be said that the monadic formula is an *a priori* affair, and reflects the thinking process only, and that its use to describe the objective world is an unjustifiable projection. There is, indeed, no answer to this charge beyond that afforded by the general outcome of the idealistic as contrasted with the realistic views; but there may be a way of using the monadic formula not merely to describe the world and the thinking process, but also to conserve some of the finest features of idealism. This brings us to the objection noted above and then postponed —to the effect that we feel ourselves to be different from the world around us. Before considering it let us note briefly the fifth proposition, which will help to lead up to our answer.

5. This proposition is to the effect that language and ideas transform emotional and instinctive complexes into sentiments and values. This transformation is effected in part by language, when the consummatory and precurrent reactions are rendered communicable, and hence more definite, and when social agencies, always active where there is language, make for the recognition of common standards. At the same time thinking renders the consummatory and precurrent reactions more abstract, more general, and more metaphorical, until values tend to be dominated not merely by ideas, but also by ideals.

6. But, in spite of all this description, we undoubtedly

[102] B. Bosanquet, *Logic, or the Morphology of Knowledge* (1888), Vol. I, p. vii.

do "feel ourselves to be different" from the world around us. How can this feeling be reconciled with the monadic formula? The answer is that precisely such a feeling is to be expected, on the basis of the monadic formula. According to the argument of this paper, the course of evolution has, as one of its notable results, the production of human social values. This production has resulted in part from what we have called (IV-b) a series of integrations. In proportion as these integrations have been different from mere aggregations, they have constituted what Professor Spaulding calls creative syntheses.[103] In them, in every case, *old things have united to form new things.* The fact that this proposition often seems impossible is due to two errors; first, the failure to recognize that, if indeed anywhere a whole can properly be said to be equivalent to the sum of its parts, it is only in the abstractions of mathematics, and especially in the number theory. In all other situations, if not in mathematics, a whole *is more than* the sum of its parts. The second error is the failure to see in the notion of newness the implicit relativity without which the notion is simply impossible. There is no such thing as the absolutely new; things that are called new have to be related to former experiences in order to be called anything at all. That old things, under appropriate conditions, unite to form new things is then the very spring of evolution—it is this process which enables the world to get from one stage of evolution to another. At early stages the atoms, molecules, astronomical bodies, etc., constitute successively the new monads. There follows a series in which the cells or the metazoa, for example, are new—they are, we may suppose, made up of monads previously developed, or they contain parts which correspond more or less closely to such monads; and they remain constantly in interaction with all preceding monads.

[103] *Op. cit.*, pp. 448, 500.

Later on, the neuropsychological monads are new, within the meaning of the term; even if the processes of integration are obscured or supplanted (IV-c) by those of differentiation, the processes of differentiation, no less, involve combinations essentially new. At length the cumulative series issues in the development of new complex reflexes and new complexes; and these develop, as we indicated, into sentiments and values. The fact, then, that we feel ourselves different from the world in the midst of which we develop is the very expression of our essential "newness." According to the monadic formula, new monads, new stages, new series, have been appearing throughout the majestic course of evolution. When at length the stage of sustained human values is reached, *we are the new things.*

IV.

Such a monadism, even when reinforced by the important considerations just mentioned, does not completely describe the concrete world. From some points of view it is hardly more than a first approximation to such a description; for it is almost inextricably involved in the detail of structures and processes, and lacks the perspective essential to a more adequate philosophy. But within the monadistic arrangement as outlined there is already implicit what we take to be the second implication of the hypothesis of epitomization. According to this view, there is something more than convenience involved in the fact that the descriptive sciences seem to fall so easily into what may be called cosmogonic, biological, and neuropsychological groups. A consideration of these groups, from the point of view at which we actually find ourselves within them, indicates the following points: 1. The chief gaps in our knowledge occur between the groups as noted, or just outside them. 2. Cosmogonic monads are, in general

earlier to appear than biological, and biological monads are earlier to appear than neuropsychological. 3. Of striking interest is it that at a certain stage, (4), in cosmogonic evolution, as noted (*i.e.*, in one of the planetary members of a solar system—the earth), when o nemight expect the course of cosmogonic evolution as thus far indicated to proceed to further integrations of higher astronomical monads, such as (5), (6), etc., some of the complex molecules within the planet set up a new series of stages, the biological, which, when compared with the cosmogonic series, may be described as a kind of internal deployment. Again, later, at a certain stage (10?) in biological evolution, as noted (*i.e.*, in some of the multicellular animal organisms which are in a group including plants), when one might expect the course of biological evolution as thus far indicated to proceed to further integrations of biological monads, such as (11?), etc., some of the complex cells within the organisms set up a new series of stages, the neuropsychological, which, compared with the biological series, may be described, again, as a kind of internal deployment. This striking similarity is not lost if one thinks of the solar system (5) and the earth (4) as arising through processes of differentiation within a larger aggregate, the primitive nebula (IV-c)—for one may also think of social groups (11?) and multicellular organisms (10?) as arising by processess of differentiation within a larger aggregate of primitive protoplasmic forms (IV-c). Taken altogether, there seems to be a point here which deserves more attention than it has received. 4. Of the nonads which most intimately concern us, the earth is much larger than any multicellular organism or social group; and any multicellular organism is much larger than any complex reflex or sentiment- or value-complex. 5. Once more, of these monads which most intimately concern us, the earth contains the multicellular organisms and social groups—we do

not live on the earth, but in it, beneath its atmosphere; and, again, the multicellular organisms contain the complex reflexes and the sentiment- and value-complexes. 6. Finally, the earth, although more ponderous in its processes, is less delicately adjusted and intricate than the multicellular organisms are in theirs; and the organisms, although more ponderous in their processes, are less delicately adjusted and intricate than the complex reflexes are in theirs.

The monadic formula, exhibiting essential similarities of structures and processes, enables us to observe parallels between any or all of the monads noted. The relations just indicated between the cosmogonic, biological, and neuropsychological series suggest that a parallelism drawn between the structures and processes of the three series as such may be of special significance. Such a parallelism, shown below, leads to the formulation of the second of the three implications of the hypothesis of epitomization, as follows: Essential similarities of structures and processes are repeated, not only in monadic stages, but in the cosmogonic, biological, and neuropsychological series as such, with successive relations of container and contained; on smaller scales; but with higher degrees of complexity—or, as it may be put briefly, *cosmogony is epitomized by biology; biology, in turn, is epitomized by neuropsychology.*

Such a parallelism would exhibit the monads and series thus:

Cosmogonic (Medium)	Biological (Environment)	Neuropsychological (Internal Medium)
(1) Electrons	(..7 ?..) Organic Compounds	(..12 ?..) Specialized Cells
(2) Atoms	(8 ?) Chromatin (?)	(13 ?) Nervous Areas
(3) Molecules	(9 ?) Unicellular Organisms	(14 ?) Simple Reflexes
(4) Astronomical Bodies	(10 ?) Multicellular Organisms	(15 ?) Complex Reflexes
(5) Solar Systems	(11 ?..) Social Groups	(16? ..) Complexes
(6 ?..) Clusters, Galaxies, etc.		

The full development of this principle of epitomization in accordance with the parallelism would require all the details mentioned in Section III of this paper, and a great many more. Without attempting a detailed treatment, we may note briefly some of its significant features. In the first place, the serial numbering tentatively adopted above is carried over. The cosmogonic series is thus made to contain more monads than either of the other series, although the number of successive monads called by the term "social group" or "complex" might justifiably be increased. But there is nothing in the principle of epitomization which would require that the number of stages in each series must be equal; and there are so many questions concerning the individuation of the later monads in all three series that it is better not to attempt further extensions for the present. As new monads are discovered or distinguished in future, it is quite possible that the parallelism may need to be modified; indeed, as it now stands, it represents a line of inquiry rather than an established result—but it is a line of inquiry which offers some striking possibilities in the way of a new correlation of the sciences.

It is noticeable, in the second place, that the parallelism sets over against one another three portions of the world which in the various sciences and groups of sciences are apt to be forgotten or neglected—the "medium" in the midst of which the cosmogonic monads develop and with which they interact; the environment in the midst of which the biological monads develop and with which they interact; and the "internal medium," which sustains similar relationships to the neuropsychological monads. Without attempting to explore the detailed possibilities here, let us note that one may construct at least a rough parallelism between current theories in these three groups of sciences, according as the milieu appropriate for each group is regarded as differing in degree or in kind from the monads

which it contains—as conforming, in a modified way, to the laws which are observable among the monads, or as having laws of its own, to which the monads form departures or exceptions.

The next line of the parallelism as shown above brings us to some monads which have what we may call an intermediary relationship between the milieu and the later monads in each series. Thus electrons, while different from the medium, are still not material bodies; organic compounds, while different from the environment, are not living forms; and specialized cells, while different from the internal medium, still do not have the properties of a nervous system. Yet, in each case, the monad mentioned is utterly indispensable for the structures and processes of the later monads of the series. Apparently, on the other hand, each of these monads in its interactions releases into the milieu something which is more akin to the milieu than to the later monads; the electrons set up radiations in the medium, the organic compounds split off less complex organic, or even inorganic components, into the environment, and the specialized cells probably discharge some physiologically active substance into the neighboring cells.

That atoms, chromatin, and nervous areas are set in parallel affords a suggestion which, taken in connection with what has just been said, may help to lift the reproach which has too long and too unjustly been heaped upon materialism. The atom, as contrasted with the electron, is admittedly a material body; possibly chromatin, and certainly unicellular organisms, as contrasted with organic compounds, are living forms; possibly nervous areas, and certainly some of the later neuropsychological monads are, while they function, conscious. The suggestion, which cannot here be developed in detail, is that matter, instead of being the antithesis of life and consciousness, tends to be their analogue. It is further noticeable that atoms, chro-

matin and nervous areas each exhibit somewhat wide variations in magnitude—the monads of each of these stages are not to be thought of as of uniform size. Atoms consist of one or more electrons and one or more positive nuclei; chromatin consists of organic compounds and nucleic acid in varying proportions;[104] nervous areas consist of one or more specialized cells and one or more nerve-cells. A question which calls for special investigation is whether there is not a significant resemblance between the interactions of atoms, with their positive and negative valencies and their valency electrons; chromatin, in its connection with dominant and recessive characters as conditioned, according to the hormone theory of heredity, by organic products split off from the chromatin of the germ-cells; and nervous areas, with their structures and processes which make possible the reinforcement or the inhibition of one reaction by another. This question involves not only these monads, but also some of the later monads of each series, and is too complex for detailed treatment here.

Concerning molecules, unicellular organisms, and simple reflexes when the last named term is understood in the sense used above, it may be remarked that each of these monads, under conditions known to us at present, is more capable of relatively independent existence than are the monads previously developed, but is less familiar to us than later monads.

The parallelism between astronomical bodies and multicellular organisms gives point to biological and physiological comparisons sometimes found, for example, in the work of Chamberlin, and to the more definite assertions of S. Meunier[105] that there are significant resemblances between geological processes and biological processes. These, again, are too complex to be discussed here; and whether

[104] E. B. Wilson, *op. cit.*, pp. 240-242.

[105] *Les Harmonies de L'Evolution Terrestre* (1908); *La Geologie Biologique* (1914).

the resemblances can be extended to the process of conduction as we have it in the monad of the third series, the complex reflex, must also be left open. The most significant point in connection with the threefold parallelism as indicated is the successive relation of container and contained, the importance of which was emphasized above; the monads of the biological series may be said to arise from some of the molecules within one of the astronomical bodies; and the monads of the neuropsychological series may be said to arise from some of the cells within one of the biological organisms. The parallelism is affected, although hardly vitiated, by the fact that we know for certain one astronomical body which is inhabited by biological organisms, whereas we know myriads of organisms which have nervous systems. There may be some significance in certain facts in connection with these monads which, however familiar they are when taken separately, seem strange when set side by side—that, as astronomical bodies, planets exhaust their energy before the suns on which they depend exhaust theirs; further, that, of biological organisms, the animals, in general, expend energy, while the plants upon which they depend store up energy; and finally that, of complex reflexes, the clonic reflexes run their course quickly, while the tonic reflexes are sustained for longer periods.

We have already noted that the parallelism between solar systems and other astronomical groups; social groups of various kinds; and complexes of various kinds, is not worked out in detail. It is only recently that the individuation of some of these monads has been recognized, and the fact that they transcend our ordinary relationships and ways of thinking renders them very difficult to treat. Possibly, when it comes to be recognized that a social group may function in super-individual ways, there may be recognized also some analogous doctrine to the effect that a

sentiment- or value-complex may function in super-ideational or super-rational ways, which may still be valid. At this point the argument for epitomization might establish contact with intuitionism and mysticism.

A few words may be added concerning the relationships of the three series when each is taken as a whole. In the first place, when the details are worked out, it may be possible to strike totals, so to speak, for each series, and point out an epitomizing relationship between the totals—thus, it can perhaps be said, the cosmogonic universe is epitomized in the biological population of a planet; and the biological population is, in turn, epitomized by the apperception mass of an individual. But for the present this generalization is too remote.

There is a certain significance, however, even in the gaps in our knowledge; for, since the chief gaps in our knowledge occur between the series, or outside them, and since spaces between them must for the present be left open, the above parallelism is at present applicable either in a mechanistic or a vitalistic biology, and in either a behaviorist psychology or a psychology which makes of consciousness a kind of intervening agent. There is a possibility that the parallelism, taken together with the other implications of the principle of epitomization, may reinforce Professor Bergson's suggestion[106] of a line of reconciliation between some of these contending schools. Perhaps the conceptions of mechanism should be employed to describe the chemical origin of the life process, while those of vitalism should be interpreted to signify the fact that the biological series departs from the cosmogonic series in what we have called an internal deployment. In other words, perhaps mechanism is properly a concept of origins, while vitalism is properly a concept of orientations of the biological series with reference to the cosmogonic. Simi-

[106] *Creative Evoluton*, transl. Mitchell (1916), pp. 30-31.

larly, perhaps behaviorism can tell us more of the origins and elementary characteristics of the neuropsychological series, while the older views exhibit more of the orientations and larger relationships of the neuropsychological structures and processes. Of course, the gaps between the series may indicate that here extraneous forces intervene —that some vitalistic impulse produces the structures and processes of the biological series, and some quasi-spiritual force those of the following series. The parallelism would, if necessary, accommodate such extraneous forces; but it is more economical of one's concepts to regard the series as appearing without such interventions. The universe, according to the view here taken, might be said to be like one of the projectiles from a modern long range gun, which, after passing through a certain trajectory, produces a second explosion, and then, after passing through another trajectory, produces a third. In the case of the projectile, one does not need to assume that forces from outside intervene to produce the later explosions; one says, simply, that the projectile is built that way. Nor does one need to assume that there are such intervening forces in the case of the universe; one can say that the universe, also, is built that way—although this illustration must not be pressed to the point of eliciting from it a cosmological or a teleological argument.

V.

The second implication of epitomization, as considered above, does not yet exhibit our concrete world in all the fulness of relations which characterize its parts; the threefold parallelism of the preceding section is still in many respects an abstraction. One further step toward concreteness (although this again is not the final step) may be taken when, instead of considering the cosmogonic, bio-

logical and neuropsychological series singly, in their relations to one another, the first and second are taken together, in their essential connection, and set in parallel to the second and third, also taken together, in their essential connection. This is quite Fechnerian,[107] although the Fechnerian consequences do not necessarily follow from it. When the first and second series are taken together, we have ecology; when the second and third are taken, we have physiological psychology. The third implication of the hypothesis of epitomization is that *ecology is epitomized by physiological psychology;* the living organisms are to the earth as the nervous system is to a multicellular organism. Of course, in the concrete world of actual experience, all three exist in indispensable and very complex relationships; but it is held that this fact adds to, rather than diminishes, the significance of the abstractions indicated.

According to this third implication, taken in connection with the others, we may say that social groups in the history of the earth may be compared to complexes in the experience of an individual. An argument, too long to indicate in detail, may be worked out to the effect that the more definitely organized and established social groups—*i.e.*, the civilized human groups—are comparable to the more definitely articulated and persistent complexes—*i.e.*, the value-complexes; and that individual men within the groups, who are either leaders or followers, are comparable to ideas within the complexes, which are either "ends" or "means." The death of an organism in the earth may be compared to the discharge of a reflex in an organism; a view which recalls the essential point of one elaborated by Royce.[108] We may say that after the death of an organism portions of it are either incorporated into other organisms, or the biological processes are succeeded by

[107] See *Zend-Avesta* (1854), Vol. I, p. 286.

[108] *The World and the Individual,* Second Series (1908), pp. 317 ff.

processes which belong to the cosmogonic series; and, similarly, that after the discharge of a reflex portions of it are either incorporated into other reflexes, or the neuropsychological processes are succeeded by processes which belong to the biological series. The third implication of epitomization has also a bearing upon the organismic theories of society; it might be worth while to see how many of the accredited objections to these theories would be removed if society were to be thought of not as an organism, but as a kind of organ, comparable, as Herbertson[109] has suggested, to a nervous system of the earth.

The general result of the three implications of epitomization is a view that the structures and processes of the universe tend, by a kind of progressive concentration throughout the monads of the three series, to be, so to speak, distilled into the social groups, and, through these, into our values and ideas. This view regards the universe as not merely evolving, with the result that men and their experiences have appeared, but also as epitomizing, with the result that men and their experiences have a significant relation to the whole. At this point the hypothesis of epitomization is in general accord with the views which construe the problem of philosophy of religion as a problem which concerns man's relation to the universe; but the implications of the hypothesis for a philosophy of religion must be left for more detailed treatment. The affiliations of the hypothesis in the history of philosophy are with those fantastic but remarkably widespread and persistent theories of macrocosms and microcosms, particularly with the view that man is a microcosm, or little universe. But the views here put forward do not rest upon this historical basis. The problem of the relation of the universe and man is, for our age, first of all a scientific problem, and calls for the contributions of the great specialists along a thousand

[109] The Higher Units, *Scientia*, 14, 212 (1913).

lines of inquiry. But it is no narrowly specialized problem; it calls also for correlation, for perspective, sometimes for speculation, and for all the resources of philosophy. The aim of this paper has been to raise the question, and to indicate some of the possible steps in its solution. It ought to be possible to decide on scientific grounds whether the construction which is here put upon the data of evolution is justified, and, upon philosophical grounds, whether the result is, or may sometime be worth while.

In connection with this argument, something should be said about the use of the method of analogy. It is our conviction that much that is said against the method is conventional, and is directed against its more obvious abuses; and that, as a method, it has yet to receive its adequate evaluation. Of course it must be granted that there are many differences between the various monads and the various series; indeed, from some points of view, the differences are more important than the resemblances. But still the resemblances are there; and when the monadic formula is developed in detail, many of the differences appear as differences of complexity in later as compared with earlier stages, rather than as differences of essential processes involved. In our argument, reliance is placed not merely upon a number of analogies, although the number is quite formidable and, if one insisted upon a logical justification of the method, might serve as data for induction to a general law of analogy under which particular cases might be subsumed. Reliance is placed rather upon what we have called the essential character of the analogies. It is held that false analogies, common in reasoning, are usually hasty or superficial analogies, but that the analogies indicated in the monadic formula and in the parallelism are essential. They are essential in the sense that, so far as we can detect, the world known to us would not have developed without such structures and processes; or, to put the

same thing in another way, they are essential because they constitute a system of metaphysics. And a consideration of the importance of these structures and processes ought to make for the view that the many striking analogies which the universe admittedly contains should be capitalized, and that new analogies should be looked for, and that old and new together should be developed into an instrument of real usefulness in science and philosophy.

GEORGE P. CONGER.

UNIVERSITY OF MINNESOTA.

ART AND THE UNCONSCIOUS.

IT has been said that "Art as the formulation of a unique and distinct psychological attitude is unquestionably one." I am in profound agreement with this, provided no implication be made that the merely psychological unity is all that we have to deal with. I mean that Aesthetic as a science based on, and limited at every point by, psychology, is nevertheless distinct therefrom, and can only interpret its data in its own way. There is no reason why the psychological unity of attitude should not appear for Aesthetic still as a unity; and I should contend that so far as our experience goes we are fully justified in applying the term art, to such different things as *e.g.*, music, painting, poetry, etc. In this sense, art is, or may be, a real thing, whose reality we must represent to ourselves as something over and above the merely psychological process through which it is experienced; or, more strictly, there is something whose presence within the psychological process is to be explained and accounted for by other than purely psychological laws; and demands the recognition of aesthetic principles. It is largely for psychological purposes, however, that I take for granted the unity of art. If there is a unity, the only secure method would be to test every conclusion by reference to every type of art one could think of. Only thus could we hope to eliminate untrue generalization. As it is, the scope of illustration must seem unduly

summarises Angelo in the rather remarkable phrase, no doubt, profoundly true—"He was proud, but not proud enough to be at peace." Titian exhibits a more complete bankruptcy of, at all events, the application of Ruskin's principles, if not of those principles themselves. It is true that for Ruskin as much as for any man some of Titian's greatest pictures are motived by religion, but there are others whose aesthetic value is in no way explicable, through the religious or ethical motive, or to be substantiated that way. And of this Ruskin eventually became aware. Perhaps it is possible, through Della Seta, to bring the difficulty to a clearer focus. The Italian Archeologist presents us with material that is of absorbing archeological interest and of enormous religious importance. But this material—is it all artistic of the quality it is claimed to be; can its value be made good as purely aesthetic? This, frankly, is what I doubt, and I should like to point out one very significant thing: that both Ruskin and Della Seta make some of their points by completely ignoring the fact of music in Reformation and post-Reformation times.

And now for the statement of the opposite view—that art as creating something that is of value in and for itself is an object that may and ought to be pursued just for the value of the beauty that it produces. The artist is here liberated from any other claim. If religious symbols offer him something which he can incarnate in paint—or other medium—and thereby help him to get the purely aesthetic quality of which he is in search, well and good. Let him use it. But the governing aim is obviously not the religious one but the aesthetic. Further, the aesthetic value is one which sets up a thoroughgoing rivalry with other values. Perhaps there is nothing in life of such worth as art. If so, there is an obligation—for the artist, of course—to pursue it at all costs. The ethical and the religious, in the old sense, becomes subsidiary. But—and this is all important

The value of a subsidiary thing, like art, was constituted by its power to adorn or interpret these; not as something worth following out for its own sake. As one of the ablest living exponents of the view let us take Alessandro Della Seta, whose book, *Religion and Art*,[1] states with extraordinary definiteness the case for religion as the uniqué inspiration and driving power of art. The development, for example, of the technique of perspective in painting or sculpture relief, takes place with a facility and completeness when a religion and an art grow up together that is not manifested under other circumstances. The motivation of art by religion goes for precision, delicacy and adaptability of technique as well as for spiritual power. But, of course, emphasis is placed upon the latter. Della Seta summarises his general conclusion in the words: "Man would never have set himself the task of representing men because of the beauty and nobility of their form. The form of men appeared beautiful and noble because it had served to clothe the Gods. Man therefore possessed art because he had religion."

Readers of Ruskin will at once perceive the close affinity of Della Seta's Aesthetic with his. Now, though, I should wish to emphasize what may appear to many paradoxical, *viz.* the thoroughgoing consistency of Ruskin's Aesthetic, I think the difficulties in this first theory with which we have to deal will become inevitably apparent if we approach them through Ruskin. The crux of his difficulty appears in his handling of the painters of the late Italian Renaissance, say, Titian and Michaelangelo. His position indeed with regard to the latter is rather curiously ambiguous. But at all events, he feels elements in Angelo's genius which he cannot justify on the principles which he would like to use. He is aware of his power and his pride, does not like them from the religious point of view, yet is baffled by them as somehow presenting very great aesthetic claims. So he

[1] Alessandro Della Seta, *Religion and Art*, English translation, 1914.

But the interpretation of the dream, the process by which we become conscious of ourselves, of the dreaming part of ourselves, is as difficult, as it is felt to be wonderful when we begin to take the first steps in it. As well as understanding the dream, we find it take on a new aspect. That is to say, the process of becoming conscious involves, among many other changes, a change in the aesthetic quality of the dream itself. It is difficult I am sure, to convince anyone of this who has not begun to realize the true nature of his dreams; one must really experience for oneself the extraordinary deepening of the whole emotional tone that may follow upon grasping the significance of even a single symbol in a dream. Everything is changed, everything becomes illumined, everything in the dream responds to the new point of view; it is like the resonance of the whole mind to the new and correctly pitched note.

The first point, then, to which I wish to draw attention in the work of art as explicable through this analogy with the dream, is that we find the same process of becoming conscious correlated with an interpretation, or a re-interpretation of the symbols employed by the artist. Now this process of becoming conscious may occur within the artist himself, or during the appreciative enjoyment of the picture or the music on the part of someone quite remote from the artist, or it may be the character which marks the phase of transition from one kind of social art consciousness to another. It will be simplest, however, to illustrate this transitional phase of consciousness or of becoming conscious through the individual artist. I shall take as an example Goethe's extremely familiar little lyric, *Wandrers Nachtlied*. The impression the poem has made on myself at different times tallies exactly with the episode related of Goethe, but of course others may feel differently. At the same time, there is absolutely no doubt in my own mind that this is actually what happens in our reading of poetry

and in our enjoyment of all kinds of beauty. The episode is as follows: In the Autumn, 1780, Goethe spent the night at a shooting box on the summit of the highest hill in the neighborhood of Ilmenau. There he wrote the familiar lines

"Uber allen Gipfeln ist Ruh,"

"Over all the hills is rest; over all the trees thou markest scarce a breath. The little birds are silent in the wood. Do thou but wait; for soon shalt thou too be at rest." They were written in pencil on the wall on one of the upper rooms. There was no conscious expression, then, of a desire for the final rest. It was only a simple lullaby. About fifty years later, in 1831, the year before his death, he re-visited the house, went upstairs, searched for the poem on the wall and amid much emotion, repeated the last two lines, "Do thou but wait; soon shalt thou too be at rest."

I repeat that it seems to me quite natural for any of us to read the poem in these two ways. There is the acceptance of its apparent meaning, an impression of simple beauty, and there is the impression that comes through the re-interpretation of its symbolism, beauty of a much greater and profounder kind. The first point, then, that I wish to make is that we must admit the place and claim of the art that remains in its own unconsciousness. Symbols spring up from the unconscious of the artist—or perhaps, quite as well—from the deep social unconscious of his time, and shape themselves in aesthetically pleasing form in the picture. But here emerges a point of difference between the dream and the work of art. Dreams are not necessarily, though some dreams may be, aesthetically pleasing; art must be so, or else it is not the matter with which we are dealing. Now, in virtue of this fact, I suggest, though I am by no means sure, that there is always present in the creation or enjoyment of art at least some trace of the transitional phase, that I have described as the becoming

conscious. The unconsciousness of art and of the dream are never quite of the same kind; their correlation seems to involve an element in the former that is not, or need not be, in the dream.

That does not alter the fact that there is some art which shows, relatively, a profound unconsciousness. I have now to indicate the connection of such unconsciousness with the type of art which forms the ideal of the first of the theories we have been discussing.

When a great artistic movement seems to owe its power to the driving force of religion in a manner generally indicated by this theory of art, it is clear that the main religious ideas, say of God, of Immortality, or the death and resurrection of Christ must be held in complete conviction. The whole of the symbolism which accompanies them and through which they are stabilized and made accessible to faith comes to the mind as real. The intercession, for example, of the Mother of God is not symbolical in the sense that it stands for some other reality imperfectly apprehended. This intercession is itself believed in literally as a fact. Our difficulty here, of course, is that even in the great primitive periods of art we shall be encumbered with an enormous amount of conventional work, or even of work totally indifferent to religious conviction. But that hardly alters the main line of our argument. We do recognize, and I suppose, art critics of all sorts and conditions of views will be agreed in recognizing, the primitive type of work that bears the peculiar artistic quality I am trying to indicate. The picture—or whatever it may be—is laid before the people as actually representing what happens or exists. The artist believes it and they believe it. But now observe the limitation of this type of work—rather, I would say, observe the extraordinary transformation it undergoes when subjected to the scrutiny of people whose art consciousness has undergone a total change. It does not cease

to be beautiful. Perhaps it becomes more beautiful. I fancy that is true of many pictures. At all events, it is changed aesthetically. The intercession of the virgin is no longer the most important symbol of religious life, or the fact of intercession is denied. If we feel totally indifferent to the virgin, the picture may be nothing more than a somewhat strange, somewhat beautiful, somewhat perplexing piece of imagery. If it was at any time, or for any appreciative critic, a good picture, it will not likely ever be totally indifferent to anyone who likes pictures. But to us of the present generation who begin to wonder very much what the intercession of the virgin really meant, it will have all the added wonder of a half-interpreted dream. But that is not my point. Interest and wonder are good things. But they are not enough here. What I feel certain of is the deepening of the purely aesthetic appreciation of pictures of a bygone age with our deepening consciousness of the psychic forces at work in epochs of history and levels of social evolution which our general cultural resources are only now enabling us to understand.

But now let us go back to the artist and the people who looked at his pictures during his own life time with what special resources they had at their command and under the special limitations their age imposed upon them.

The artist as believing the liberal intercession of the virgin was unconscious of the nature of his own soul and of the forces at work in the social consciousness generally—unconscious, that is to say in a sense in which the art lover of a later time is not unconscious of these things. Now here I must try to distinguish two points of view—to distinguish them first, but really in the hope of showing that they may not be so different as I state them. It might be a real intellectual gain for the artist to become conscious of the hidden forces thus operating within his art instinct while yet it might be, aesthetically, either hurtful or in-

different. The point of view therefore of which we have to make sure is defined in the question whether or not it be of *aesthetic* value for the artist to interpret his own work in the sense of coming to a deeper consciousness of the symbols he employs. I contend, first, that it is in any case of aesthetic relevance and import whether he do or do not so become conscious; and in the second place, that art never really comes to its own until in some measure at all events it shows this increased consciousness. Or, in other words, I say that one of the great contributions that art makes to human life is in its interpretation of those marvellous symbols that our unconsciousness whether individual or social is continually bringing up to us. But this contribution may be intellectual, or economic, or what-not. Well and good so far as it goes. I should not therefore be content until I could prove that this contribution has also its purely aesthetic value. That is to say, that art locked up in its unconsciousness does provide us with beautiful things; but that the beauty provided by art which is conscious of itself and can by genuinely artistic means offer the interpretation of its own symbols, is of a higher order; and further, that this phase of transition, of heightening and deepening consciousness, must be one of profound importance for any attempt to say what the nature of art really is and what its value is alongside other values in human life.

These considerations should help us not perhaps to state, but to indicate, the limitations which the ethical or religious view of art imposes on it. So long as the reality of the symbols belonging to primitive religious faith is a matter of absolute conviction, there may be enormous driving power available for art production, but such conviction sets correspondingly strong forces at work which operate against the emergence of that particular character of art in virtue of which it can become its own interpreter. What, then by way of corrective or supplement, has the other

theory of art to give—that art, in its own right, has a place in life, and that it is at least legitimate for the artist to work in the full consciousness of the pure aesthetic value as an end to be realized?

First it is only in the full consciousness of this purely aesthetic purpose of art that we can entirely free ourselves from the confusion produced by the presence in it of qualities, in themselves excellent, but possessing a value which is not purely aesthetic. We do not, of course, know, we can at best dimly feel, what constitutes excellence in art *qua* aesthetic. It may involve things ethical, religious, economic, historical; or it may not. The excellence of different forms of art, music, architecture, poetry, etc., may involve these things in different degrees; or it may not. But it is profoundly important that we should not seek in art, for aesthetically extraneous qualities; or allow a bias in ourselves in favor of certain things we like which are not wholly in subserviance to beauty. To admit that it is sometimes possible, or that it is in some way possible, to be conscious of a strictly aesthetic purpose in art will perhaps be one of the things that may help us to this impartiality of appreciation. But further, such a view is most useful as taking up an attitude of uncompromising criticism towards those societies, or epochs of social development, in which religion has indeed been powerfully operative, but has been unproductive towards art. In the claim made by this theory for the fundamentally religious character of attention or devotion to art itself as the aesthetic end, it is formulating a doctrine that human life cannot afford to do without. Granted that the aesthetic is either the greatest value, or one of the great individual self-substantiating values exerting claim upon human experience, the ministry of art becomes a correspondingly urgent religious function.

This is, no doubt, a very curious inversion of the accepted relation. And it is just in this relation that some-

thing will have to be said in criticism of the whole view and of the attitude which it implies in the artist. Religion it may seem is somehow wrong placed with respect to art. It ought to be the channel of nourishment for art, to provide its contact with the earth—with the deep-lying, universal instincts of our nature, with what has been called the collective unconscious. Let us examine, then, the nature of this possible defect in the light of what help we can get from the psychology of the unconscious.

When an artist works under what I have called the compelling power of religion, he does not set out as it were wondering to himself what symbols he shall use. Rather they are presented to him. And when he is confronted with, say, symbols of sacrifice or submission, cast up before him as it were by the turbid waves of his unconsciousness, he has got to accept them. If he refuses them, or eludes them, his whole inspiration lapses. His strength as artist depends upon his allowing himself to be carried along by the flow of his own individual psychology, a power which he does not know and which, in its main current, he does not attempt to control. By this means the artistic handling of his problem has the stability given by the convergence of all the lines of symbolism which belong to his unconsciousness from his birth, or even from his pre-natal existence. They all concentrate upon that problem and he has behind him the power of their united and convergent action. It might be possible to illustrate this in a hundred ways from Dante alone. On the other hand, the artist who has freed himself from this compulsion exerted by religion, and who is out consciously upon the search for discovery of beautiful from alone, may choose from among the various symbols presented. But in virtue of the exercise of this choice, he is liable at any moment to step out of the main primitive currents of his psychology. If he does so, the stability of his attitude to the problem is gone. What happens is that

he merely dips down into the unconscious, and brings up this and that isolated symbol. His very consciousness of his aim is something that defeats itself. For a symbol by itself is little or nothing. It is its psychological setting alone that gives its significance and its power. That is why so much modern art seems to be of the nature of the play of little bizarre phantasies and curious forms—that please, no doubt, yet which are felt to be strange and bewildering as much as pleasant. And yet the movement is full of significance. The artist liberates himself to anything that comes from the unconscious, to anything that seems beautiful. For the world of the unconscious is of enormous interest, and the conviction of the artist is always that it is the very stuff out of which beauty is to emerge, the raw material of beauty. Let us give it free play in art; set it to work to amuse us, and let us entertain ourselves watching its bizarre freaks. They are instinctive, natural. They have the right to expression. Nothing else will furnish the true forms of art. Anything else is too intellectual, too sophisticated. And so the extreme of consciousness goes out upon the search for the extreme of unconsciousness. Nor may we justly object. Besides, the very oddness and intractability of those bizarre phantasies involve the discovery and invention of new art forms and new methods.

There are many of our dreams that arouse our interest, but are so extremely odd that is difficult to communicate them by any ordinary means. When you are talking to a lady who is looking straight at you, you cannot, under the conditions of time and space, see the back of her. But you can do this well enough in a dream. Such a dream is difficult to render aesthetically in painting, still more so, perhaps in music. Nevertheless, to confine ourselves for the moment, to the simpler problems of the two, an attempt could be made by the former art to render the characteristic

peculiarity of the dream. Such, I take it, is the explanation for example, of cubism in modern painting, say Picasso's picture of the *Lady in the Armchair*. This is probably nothing else than an artistic device through which our unconsciousness can disport itself with a little more freedom, and admire, at one and the same time, aspects of the lady that under the limitations of our waking consciousness cannot so be enjoyed. The picture takes on the fascination and mystery of the dream, with not a little of its fear. The lady is veritably alive with motion—motion, inscrutable, formidable, concentrated—as in the lightning flicker of her fan. Most dangerous—as if yielding unwarily to a seductive vertigo, you should tumble forward, be whirled round, and your universe blacken and founder in an *eldrich scraich*.

We cannot on the whole, treat altogether lightly this effort at a direct approach to beauty, or the conscious attempt on the part of the artist to avail himself immediately of the resources of the unconscious. It is only a guiding principle that is absent, though that indeed may be difficult to discover. The problem of art would therefore be to obtain a full consciousness of its aim and value as purely aesthetic while yet the artist should not lose the driving power that seems to come only from a conviction of the reality of other values, not aesthetic, or at least not necessarily aesthetic. So stated, this seems little other than a paradox. Yet as a matter of historical fact, we should no doubt find all degrees of relative emphasis. I am myself inclined to the view that the great times of art in the world's history belong to the periods of not quite complete liberation from primitive convictions. The crest of the wave of such a movement is perhaps what brings about the final liberation. That is why the period of perfect liberation seems often enough to be coincident with the emptiness and desolation of the spirit. But in this regard history seems to teach a clear enough lesson. The greatest art

movements are wave-like in character. The crest is magnificent, and catastrophic. In the period immediately succeeding the decline, it has always been the habit of people to bewail the fall and to look about helplessly for some continuation of the art-life along the old lines. This seems totally wrong. What history gives is the revivification of the undying instinct to beauty—but in some totally new and different form—a form beyond the scope of any prophecy.

This character of climax seems, therefore, to belong to art. Where you find magnificent art, make up your mind for the catastrophe. In fact, this seems as inevitable, and as natural, as for a man to awake out of sleep. That there is a fundamental aesthetic value in the coming to consciousness by art of the meaning of its own symbols is not incompatible with the probability that this act or transitional phase is something that eventually strains it, as art, to breaking point; and therefore banishes, for the time being all possibility of the value in question. Yet this straining does not seem capable of resistence or check. Perhaps it is like birth, and its contribution to life greater than one might suspect.

At least, this is how I interpret the work of an artist like Beethoven. It is not that he gives us Wagner. Wagner is excellent, but he does not explain or validate Beethoven. What Beethoven gave to Europe was liberation. Europe needed liberation more than anything else, and perhaps this liberation that he gave was for the time being incompatible with the soaring music of the Bach-Mozart-Beethoven type.

One word more. We have need, we have discovered, of our dreams, and of all that the unconscious can give. But in the cold day-light of awakening we are not really cut off from that unconsciousness. We have access to it, and we can utilize it. If it is part of the excellence of art itself that

at a certain stage it comes to a sudden end, there is a relation to establish between the reflective mood thus deprived of power artistically to express itself and the foregoing period of more emotional or artistic life. The problem of the relation of art to reflection and to other non-aesthetic spheres of culture and of life has hardly yet been entered upon. Yet it is one of almost infinite scope and possibility.

J. M. THORBURN.

CARDIFF, ENGLAND.

CRITICISMS AND DISCUSSIONS.

CROSS-PURPOSES IN AESTHETIC THEORY.

The recent symposium on "Mind and Medium in Art," printed in the British Journal of Psychology for October, 1920, affords a capital occasion for appraising the present status of aesthetics. There is surely need for such appraisal; and though a short summary like this must omit many points of interest and value, it may, by putting together both the common ground and the chief divergences adduced by the five contributors, indicate the main directions in which a sound aesthetic theory ought to proceed and the main perils which it ought to avoid.

The first two disputants advance views which bring before us a sharp opposition. Mr. Charles Marriott, who opens the discussion, contends that distinctions between the several arts should be based solely on the medium—"the tools and materials"—employed, not on any such criterion as reproduction or non-reproduction of nature, and that such distinctions cannot soundly be drawn *within* any art. Hence aesthetic enjoyment is absolutely dependent on a recognition of successful use of the medium. "If it be objected that the reason is practical, my answer is that practical and aesthetic reasons are at bottom the same thing; or, to put it another way, that aesthetic appreciation is dependent on the sense, which may not be conscious, of practical problems effectively solved" (p. 2). And again, "The objection that we can enjoy works of art without knowing how they are done, and that in moments of highest aesthetic enjoyment we become unconscious of the means, is only apparent. Directly the means are used out of character we *do* become conscious of them, whether we understand their characteristic use or not" (p. 4). Hence the conclusion that the medium employed furnishes the sole valid basis of discrimination, and that the time-honored distinction between arts and crafts is illusory.

To this bold pronouncement, Mr. A. B. Walkley opposes a more traditional doctrine. He looks with suspicion on this emphasis on

the external, and bids us turn our gaze inward. "The inquiry from without having failed to bring us to the goal, may we not have better luck in trying the method of inquiry from within? After all, that is the normal method. The history of aesthetics through the ages runs mainly along that line. Aestheticians, from Plato onwards, have nearly all agreed in supposing that art is primarily a 'function,' as the mathematicians say, of the artist's mind, rather than of his medium or of his tools" (p. 11).

In this sharp conflict of two one-sided views, it is evident that the second offers rather less hope of profitable results than the first. Aestheticians "from Plato onwards" have abounded in mistaken judgments just because they have insisted on inquiring from within, instead of ascertaining, as widely as possible, the facts of actual artistic accomplishment. Art was an element in human life long before explicit philosophizing, let alone aesthetic theorizing, began; and it is at least likely that a direct, even if hasty, approach to actual conditions will yield more profit than will a premature attempt to draw aesthetic conclusions from a general philosophical position, before the more special field has been surveyed. Aestheticians have too often been prone to shelter themselves behind great names, and to ignore facts which could not conveniently be brought under the accepted formulas.

It is just this error of premature conclusions that the fourth and fifth[1] contributors to the discussion avoid. Mr. Edward Bullough lays out the aesthetic field with gratifying comprehensiveness. "We would, I believe, all agree that art represents but a segment of the whole range of aesthetic activity. The aesthetic attitude embraces the appreciation of natural objects, as well as of artefacts; it covers certain borderlands of art, such as ceremonial and ritual, which have admittedly aesthetic affinities; it permeates ordinary human intercourse in what we vaguely call 'manners.' As a matter of personal conviction, I hold that there is nothing in the whole range of personal experience, from sheer sense-experience to the most abstract thought, which may not be the objects of aesthetic contemplation" (p. 27). From this hopeful beginning, he goes on to develop a theory of the static and the dynamic aspects of art, the former denoting art-objects as external things, the latter their relation to the creative artist or the actively appreciating recipient; to point out

[1] Exigencies of space compel me largely to pass over Dr. Watt's paper, which is more concerned with special topics than with a general survey, and is less easily summarized.

the corresponding errors of treating the artist *in vacuo* and of over-emphasizing the social aspect of art; to discuss the correlation of medium and experiment; to analyze the idea of technique; and to sketch a theory of the imagination. We have exchanged the sharp conflict of isolated views for a broad and inclusive outlook, with a gain in justness of perception that is manifest throughout Mr. Bullough's paper.

The same spirit informs the paper by Professor C. W. Valentine which closes the discussion. He, too, has a pair of errors to note in much previous theorizing. "The best known theories of the beautiful seem to err in the following respects: they take one aspect of the aesthetic experience, or one or more characteristics of certain beautiful objects, give quite convincing illustrations of these isolated factors, and then generalize as to beauty or the aesthetic experience. Very varied theories can easily arise thus; for so complex are aesthetic experiences that many varied elements may have a share in such experiences. Still more readily can we generalize if we limit our field of discussion to one of the arts" (p. 47). And again, "The whole question as to what is beauty, or what is the aesthetic experience, has been unnecessarily complicated, in my opinion, by the undue attention given to the activity of the artist. If it be granted that we can have a truly aesthetic experience without ourselves creating (externally) an object of beauty, it seems unnecessary to introduce at first a discussion of the artist's creative activity in our search for our theory of the beautiful. At least, it gives us an additional problem to solve, and in facing it there is usually a failure to recognize the extreme complexity of the mental processes involved" (p. 49).

If we now look about for the common ground on which this lively interchange goes forward, we find one portion of it in the emphasis on the concrete work of art as the only safe point of departure. "It seems perfectly clear and certain," says Dr. Watt, "that without a basis of sensory beauty there can be no work of art. Pure intuition or not, a work of art must be created, it must be embodied, and beauty must permeate its whole being, sensory, perceptual, imaginative, from whichever end of the series its soul may spring" (p. 20). It is the merit of Mr. Marriott's view that it emphasizes this; it is its defect that it emphasizes the aspect of technique too exclusively, so that, as Mr. Valentine points out, his dictum as to the importance of the medium has greater validity in its negative form.

The more unfamiliar the medium, the more conscious we are of the technique as a separable element; though in any case, defective use of the medium is always detrimental to aesthetic satisfaction.

But to lay too much stress on the importance of the medium is clearly unwise. Indeed, we can scarcely avoid asking why, if differences of medium are so important as to be the constituent principle of the division between the arts, there may not be other differences of corresponding importance?—such as differences of temperament, attitude, intention, on the part of individual artists. These, too, might furnish an occasion for fresh groupings. On general principles, it is unlikely that the separate arts should be irreducible units; nor does the failure of any single mode of analysis prove them to be such units. Because the differences as currently drawn are confused or hard to apply, it does not follow that they are negligible; they may but need closer examination, and clarifying. Indeed, any term which has been long and widely used must apply to *something;* and it surely is better to see just what degree of correspondence to truth and of application to actuality it possesses, instead of flatly discarding it.

A second point is the sense of the complexity of the aesthetic field and of its phenomena, of all which art in the stricter sense is but a segment. We, therefore, need a specific name to designate this special province; as a provisional measure, we might restrict the name "aesthetic theory" to it. At all events, it occupies its own place, and many of the results of experimental aesthetics apply to it, but remotely or partially. In it, however, we have the aesthetic experience in its most highly developed and concentrated form, and hence use it as the field in which aesthetic qualities are best displayed, and the theoretic study of them is most richly rewarded. But to disentangle complexities aright requires us to keep our modes of approach as distinct as we can.

This field of fully developed artistic experience offers us the triad of work, artist, and recipient, each with its contribution to the total complexity, and each with its special set of dangers attendant on over-simple conceptions. The importance of the individual work has already been brought out; but the problem of the artist, though, as Mr. Valentine says, it may wisely be postponed, can hardly be left out of account. The problem is admittedly difficult; we may reconstruct an artist's probable attitude on insufficient or faulty evidence, and even his own testimony as to method and intention may not be wholly reliable. An artist may not be conscious of all that he has

put into his work, and himself be unable to account for the value which it ultimately assumes; and conversely, he may have done all that he intended to do, and still have accomplished nothing of permanent worth. And lastly, since works of art are not produced in a vacuum, there is the problem of the recipient; the qualities of sensitiveness, response, flexibility, range of interest, which he should have, the defects of dullness, inertia, rigidity, narrowness, of which he should rid himself; not to mention the extraneous influences of fashion, prejudice, and the like, which must be removed or allowed for.

Here are surely questions enough to provide discussion for a good while; but even if, in the interest of manageability, we set aside those raised by artist and recipient, the work itself remains if anything does, and is often our only basis for surmise as to producer or reception. We know practically nothing of the specific mentality of Egyptian craftsmen or Greek sculptors; they may not even be identifiable as individuals, but we derive very decided impressions from their works, and indeed, use them as starting-points for whatever we infer as to the artists' personalities. And what enables us to do this, if not the fact that the works were the outcome and embodiment of their creators' experience, now, by their survival, able to be adopted and incorporated into our own experience today?

If art thus mirrors experience, it is easy to account for the many varying views which have been held concerning its value and significance. There will be as much disagreement about them as about the corresponding traits of that general experience which art reflects. Temperamental differences will play the same part in aesthetics that they do in philosophy at large; what is vital to one observer will not always seem so to another, and such disagreements, while mankind retains its present constitution, will never be settled by argument. Despite the incidental optimism of several of the contributors to the symposium, there are very few points on which "all" will agree; and I myself have no illusions that the common ground thus far brought out will prove to have universal acceptability. It is enough if it commends itself to a sufficient number to make its occupation really fruitful—as indeed I believe it will.

At the same time, it is easy to exaggerate the amount of conflict which prevails both in individual aesthetic judgments and in general aesthetic theory. Dr. H. Wildon Carr has darkly alluded to "inextricable confusion," "widest divergence in the varieties of aesthetic theory," and has even gone so far as to say, "No two individuals.

whatever degree of culture they possess, seem able to be of one accord in their aesthetic judgments, nor does anyone seem able to preserve his own aesthetic judgment invariable." But after all, are such divergences really wider in aesthetics than in philosophy as a whole? I suspect that the reason that they seem so is that aesthetic views enter more extensively into ordinary discourse than do purely metaphysical positions; but surely the latter, as at present held, diverge widely enough to satisfy anyone. It is, perhaps, significant that Dr. Carr makes his sad discovery in the course of an examination[2] of a system which has indeed done much to introduce confusion into current discussions, and which is the direct antithesis of the position developed in this paper—the system of Croce.

Here we have neither time nor space for any real examination of Croce's doctrine; I need only say that I fully endorse the doubts expressed by Messrs. Bullough and Valentine. Like the former, I am uncertain "in particular, about the nature of the 'intuition,' the essential 'lyricism' of art, and their consequences." It is not merely that Croce's positions often seem in direct conflict with ordinary experience, but that they present notions which neither convey meaning in themselves nor help in solving aesthetic problems. What, for instance, shall we say of the dictum that "if we think of man at the first instant that the theoretic life is disclosed to him, his mind still unburdened by any abstraction or reflection, he in that first instant, purely intuitive, could be nothing but a poet"?[3] Does this hypothetical phantom resemble any poet we have ever heard of, or represent anything which the analysis of experience actually discloses? Or what shall we say of this: "The work of art is a spiritual fact, and therefore is never external (physical). A statue of a series of tones may be weighed and measured and counted by the physicists, who are wholly indifferent to the spiritual significance of what, to them, are external things. But for the aesthetician there exist no things which are measured, weighed, or counted; there exist only images, spiritual acts. To find a passage or a connection between the spirituality of the image and those physical complexes of colors, sounds, and voices is a desperate task."[4] Is the difference between bronze and marble relief sculpture a difference solely of "measuring, weighing, and counting"? Does the difference between a sequence of notes played on a flute and the same sequence played on an oboe consti-

[2] *The Philosophy of Benedetto Croce*, pp. 155, 153.
[3] *Problemi d'Estetica*, p. 15.
[4] *Ibid.*, p. 468.

tute exclusively either an immaterial image or a mere problem in acoustics? A theory of aesthetics which leaves such questions out of account is surely an oddity; and indeed Croce's whole system seems to me an extraordinarily persistent attempt to impose a set of water-tight intellectual compartments on the broad current of experience. One might even go so far as to maintain, in exact opposition to Croce, that we can conceive, say, of a physics of literature, a chemistry of literature, a psychology of literature, and a metaphysics of literature—that is to say, of the points of view of physics, chemistry, psychology, and metaphysics applied to the experience reflected in literature in a manner analogous to their application to what experience directly furnishes. This may be extreme; yet, I am not sure that it goes so far in its direction of error as Croce does in his.

But to return from the Crocean problem to our previous standpoint: it may be remarked that the latter makes it necessary to determine how close and how extensive is the contact of any particular art with experience, and whether its presentation of it is direct or indirect. Literature is obviously, of all the arts, that in which the contact is at once closest and most varied, to such a degree that under our present system of education we are prone to interpret other arts in terms of it. Yet in ages which were less subject to the tyranny of the written word, painting and sculpture conveyed many ideas which we now receive through the medium of literature. At the other extreme stands music, which has at least in modern times, been perhaps the most specialized of the arts, and certainly the one least susceptible of an informative application. As for the immediacy with which the arts present experience, literature again occupies the most intimate position, in an age when knowledge of reading and writing is so widely diffused; painting and sculpture can be directly seen, though not necessarily grasped in plastic terms; whereas music and drama by the very law of their being, need an intermediary. It is conceivable that a race of beings might exist for whom musical sounds were as direct a medium of intercourse as speech and writing are for us; but we are not such a race, and even the trained musician does not long forego the translation of written music into audible. In this field Mr. Marriott's principle of the value of technique has obvious and extensive application.

If, then, art is the embodiment of experience, nothing that experience offers is necessarily alien to it. Yet, in effecting that embodiment, it will choose with an aim which is not identical with that of

the philosopher, or the scientist, or the man of action, and it will bestow on the selection and handling of the medium a care which they need not always employ; if indeed the medium be not one of which they can make no special use. The aim of art will be, as Mr. Bullough has finely said, "Vision conceived in terms of the medium." It will not be a substitute for experience, but it will render permanent much that we should regret to lose, and the making of it permanent is itself a delight. "Even for the artist," says Mr. Valentine, "I can scarcely believe that the richest experience is always in the creative imagination; but rather that normally, especially in visual art and in music, the artist embodies his imaginations in a medium not only to communicate them to others, as Mr. Clutton Brock holds, but to make fuller and more intense his own aesthetic enjoyment. The testimony even of some poets goes to show that the impulse to write is dependent on a craving to enjoy more fully than can be done in mere imagination that which they cannot find in real life. 'If we had life,' wrote Wagner, 'we should have needed no art'" (p. 54).

These last words, however, somewhat overshoot the mark. Art is not merely an escape from the actual; its use is not "to give some shadow of satisfaction to the mind of man in those points wherein the nature of things doth deny it," as Bacon conceived, or to seek, as with Pater's Watteau, "after something in the world which is there in no satisfying measure, or not at all." If we *had* life, in the sense of absolute experience, we should not need art—nor philosophy, nor any other of the means by which we attempt to retain and unify our fragmentary and elusive existences. But, while we are as we are, we shall need art; and if we are to understand what we are about, we shall need a sound theory of art—a theory which gives due place to all the factors of the aesthetic result, without over-estimating any; which sees the artist in his environment, not in a social vacuum, but which exaggerates the importance neither of him nor of his surroundings; which appraises the sensuous no less than the mental aspects of the work of art; and which regards no element of the whole as too simple for careful discussion and analysis. It is precisely because the British symposium seems to offer so many bases for the establishment and progress of such a theory that I have ventured on this commentary, with the further hope that on this side also it may serve as a rallying-point.

CHARLES E. WHITMORE.

NORTHAMPTON, MASSACHUSETTS.

THE PRINCIPLES OF THE FUNCTIONAL CALCULUS.[1]

In the following pages, we shall endeavor to characterize a development of thought which assuredly constitutes the most important manifestation of contemporary mathematics. This development deserves to attract the attention, not only of geometricians, but also of those philosophers interested in the evolution of the principles of science. The theories to which the name of "functional calculus" has been given have been obtained by going back to the very origins of mathematical science, by thoroughly examining and generalizing the notions which form the basis of analysis itself: operation, function. Strictly speaking, the functional calculus does not constitute any particular theory with rigid boundaries. The somewhat vague denomination of "functional calculus," "calculus of functions" would include the whole of analysis; and indeed the functional calculus is essentially a generalization and an examination of the principles of classical analysis.

In accordance with a method we have already used, it is our intention to emphasize the essential ideas of this phase of the development of mathematics and to show their genesis. Our point of view is thus in marked contrast with that of an encyclopedia the main object of which is to sum up the greatest possible number of particular facts, without troubling too much about the way in which they are connected with one another.

The various streams of ideas we shall isolate from one another in order to comment upon them for the requirements of exposition are really interblended. There is always something arbitrary in the process of cutting the bonds which unite a notion with connected notions. The "mysterious unity" mentioned by Charles Hermite, which brings together "theories apparently farthest separated," loses its mysterious character when we remember that originally, and for the purposes of logical demonstration, we cut up real, complex, and synthetic notions into bits and, so to speak, work on these fragments of ideas. The task of genius will often be to bring together these fragments that had been separated.

We will take almost a commonplace example as an illustration. It has long been possible to regard algebra and geometry as two

[1] Authorized translation by Fred Rothwell, from the *Revue de Métaphysique et de Morale* of July, 1913, Vol. XXI. pp. 462-510 (condensed).

distinct sciences. Descartes, however, has shown that they are closely linked together, and pointed out the immense advantage to be obtained by combining the two.

Consequently we shall study separately theories which have sometimes developed independently of one another, and have sometimes interfered. For the reasons we have just explained, it will be almost impossible to make any hard and fast distinction between these different lines of investigation.

By a circumstance anything but fortuitous but rather inherent in the nature of things, the new theories were on the point of supplying mathematical physics with a powerful instrument of calculation. Indeed, to discover fruitful theoretical principles is the same as to grasp, for our calculations, directions which coincide with the structural lines of the real. The wonderful facility with which the integral equation of Fredholm applies to the problem of Dirichlet, a problem that typifies a large number of problems in physics—"elliptic problems"—is simply an illustration of this fact. Volterra, Hadamard, and other mathematicians utilized the new methods in various branches of mechanics and physics.[2] These numerous applications testify to the fecundity of the ideas; they constitute, as it were, the guarantee of their "objectivity." We shall not concern ourselves with these applications to physics; suffice it to mention that they are both numerous and important.

What is the origin of this *ensemble* of theories now called "the functional calculus"? What are the fundamental ideas of this mathematical doctrine? Taking solely the theoretical point of view and dealing with the matter in the way indicated, such are the questions we wish to answer.

With the above-mentioned reservations, we will trace back in three principal directions the phase of the development of mathmatics, the history of which we shall attempt briefly to describe. At the outset we shall study the generalization of the theory of operations; this generalization constitutes the formal part of the theory, but in our opinion it has had considerable influence in the formation of ideas of a more concrete character. Leibniz seems to have been the first to study the formal laws of operations (the resemblance between the formulas which give the development of the power of a binomial and the derivative of a product of two functions).

[2] See Heywood and Fréchet, *L'Equation de Fredholm et ses applications á la physique mathématique*, 1912, and Kneser, *Die Integralgleichungen und ihre Anwendungen in der mathematischen Physik*, 1911.

These investigations, moreover, dealt with the philosopher's conceptions relative to formal logic. At the beginning of the nineteenth century, Servois endeavored to formulate the general properties of operations: commutativity, associativity, etc. Besides, as Pincherle has remarked, there is in Servois a certain confusion between *operation* and *function;* this confusion, however, might be called a happy one; for the development of thought we are describing was bound to end in regarding *operation* as an *object* (a kind of function): mention is made of the equality, the univocacy of operations, and also of their commutativity, their associativity, etc. This is the conception, in its generalized form, that has been reached by Pincherle and Bourlet. The latter, for instance, gives the name of "transmutations" to a very general class of operations which is defined as follows: we say we have defined a transmutation when we have enabled one or more functions to correspond to any function. Change of variable, derivation, integration are transmutations. Operation has become a functional correspondence.

The second stream of ideas which we shall study, one that has developed either along parallel lines with the first or by uniting with it, is of considerable importance. The ideas with which we are now about to deal are really the ideas at the very base of the infinitesimal calculus. Volterra, in his opening lecture at the Sorbonne in 1912, clearly showed that the theories which Fredholm, Hadamard, and himself have thought out the last few years, are connected with the elements of infinitesimal analysis, forming, so to speak, its necessary development. We should not follow up this development were we certain that the fine pages to which we allude were accessible to all readers.[3]

We have seen briefly how the concept of operation has become generalized. The idea of function has also undergone profound transformations since the time of Bernoulli, when, under the name of function, certain relations (algebraical, logarithmical trigonometrical) were said to bind a quantity y to a variable x. The integration of equations with partial derivatives of the second order led D'Alembert and more especially Fourier to a far wider conception of function than Dirichlet seems to have had, in its most general form, when he regarded uniform function as any *correspondence* whatsoever between a value of x and a value of y.

And so the idea of correspondence which constituted, as we

[3] *Revue du Mois*, 1912.

have seen, the fundamental nature of operation also forms the essential element of function. Having attained to the notion of correspondence or of relation, we seemed to have reached the most general conception of function. It was still possible, however, to generalize the concept of variable. This idea was necessarily inevitable. Function, indeed , is the unknown of functional equations (taking the expression in its broadest sense), i. e., the unknown of a differential equation, one with partial derivatives, integral equation, etc., as a number is the unknown of an algebraical equation. A *rapprochement* had to take place between the *numerical* variable and the *functional* variable. Volterra seems to be the first (about 1887) to have envisaged a function which depends on the *form of a line*, i. e., to have considered a function as dependent on a *continuous* infinity of unknowns. Henceforth the form of a line intervenes as an independent variable; a function depends on a continuous infinity of variables. In a daring generalization, Volterra extended to the functions of lines the fundamental notions of the infinitesimal calculus: continuity, derivative, differential, development in series of power, analyticity. Following the same line of thought, Hadamard considered functions depending on the form of another function (these are not functions of functions) which he has called *functional*. The calculus of Variations, which includes the whole of analytical mechanics, affords an instance of functions which come into this category, as, for instance, the integral which is to be made minimum depends on the form of a function.

Whereas the ideas just developed are essentially connected with the notion of continuous infinity and thus with the geometrical intuition of the continuous which is the foundation of geometry and the infinitesimal calculus, another orientation (the third stream of ideas we wished to mention) was about to appear, the one which, invoking the name of Weierstrass, we might call the arithmetical orientation. At the base of the arithmetical conception appears as the fundamental element the idea of a development in series, Taylor's series, Fourier's series, etc., a development the ensemble of whose coefficients has the same *power* (in Cantor's meaning) as the sequence of the natural integers. This was the point of view assumed by Le Roux, Hilbert, etc., when they considered that a function may be looked upon as dependent on an enumerable and therefore *discrete* (no longer continuous) infinity of independent variables: the coefficients of its development. The coefficients of a Fourier development, for instance, constitute the infinity of independent variables

on which depends the function represented by this development. In the language of geometry, a function may be considered as a point of space with an enumerable infinity of dimensions, each variable representing coordinate. Obedient to kindred ideas, moreover, Hill, Poincaré, and at a later date Helge von Koch, had already considered systems of a discrete infinity of linear equations with an enumerable infinity of variables. By conceiving of analysis as algebra wiith an infinity of variables, the concatenation of the ideas at the root of algebra with those that serve as a foundation for analysis is firmly established. In algebra indeed we have to determine a finite number of magnitudes by means of a finite number of equations; in analysis a function must be determined by means of a functional relation. As Hilbert remarks, a function may be regarded as known when the enumerable infinity of its coefficients is calculable: now, these coefficients may be determined by a *discrete* infinity of equations, and this system of an infinity of equations with an infinity of unknowns will be equivalent to the functional (differential, integral, etc.) equation. Thus we understand how analysis may be said to be the continuation of algebra. Hilbert endeavored to systematize the notions relating to functions with an enumerable infinity of variables: he dealt more particularly with quadratic and bilinear forms with an infinity of variables.

We have attempted to show that the functional calculus is at the meeting-point of a threefold development: the generalization of the formal properties of operations; the extension of the notions of the infinitesimal calculus, the fundamental idea of which, at the outset, is continuous infinity (the generalized function, in this case, depending on all the values of a function in an interval, a conception connected with the notion of the definite integral); and finally, the generalization of the arithmetical point of view, a function here being conceived as depending on an enumerable infinity of variables. To endeavor to establish, as has sometimes been attempted, that one of these last two conceptions is, speaking absolutely, superior to the other, appears to us meaningless, for we are confronted with two equally fundamental modes of inquiry. The one can be traced back to intuition and the geometrical continuous, the other is related to the primitive elements of arithmetic: to the natural sequence of numbers. The history of the theory of analytic functions teaches us, for instance, that geometricians, following their natural inclinations, have taken up the study of mathematical facts sometimes according to one conception, sometimes according to the other.

The reason why we have hitherto refrained from speaking of those new forms of equations called integral and integro-differential equations, is because we wished to make a clear distinction between fundamental ideas and the applications that can be made of them. The solution of integral integro-differential equations, as also the solution of differential equations or equations with partial derivatives, consists in the determination of a function in the ordinary sense. But the most satisfactory methods that have been decided upon for solving these equations are directly connected with the ideas we have set forth. It was with reference to a problem in mechanics that Abel first met with an integral equation, i. e., an equation in which the function to be determined is represented under an integral sign. Volterra and Fredholm, dominated by the fundamental conception according to which the unknown function depends on a continuous infinity of unknowns, have considered the integral equation as the limit case of a system of n linear algebraic equations with n unknowns, obtained by splitting the interval of integration into n parts;[5] the solution of the integral equation will be given by the limit of the solution of the system of equations: the continuous infinity of the solutions of the system will constitute the totality of the values of the unknown function in the interval of integration. In an integro-differential equation, the derivatives of the unknown functions are represented under the integral sign. The integro-differential equations of Hadamard approach the ordinary differential equations, those of Volterra approach the equations with partial derivatives of the second order, and he solves them by combining his method of passing to the limit with the methods used in solving equations with partial derivatives of the second order.

The equations with functional derivatives mainly envisaged by Hadamard and his pupils are different from the integral and integro-differential equations, because the unknown is no longer a function of a variable (or of a *finite* number of variables), but a function of lines. Whereas the integral and integro-differential equations may have appeared, and the integral equations actually have appeared, in the applications, previous to the development of the ideas we have just set forth, the equations with functional derivatives could only be envisaged when the functions of lines (or the "functionals") were known.

[4] P. Boutroux, *Revue de Métaphysique*, Nov., 1904.

[5] Volterra, *Leçons sur les équations intégrales et les équations intégro-différentielles*, Paris 1913.

We have seen how Volterra and Fredholm regard integral equations; their conceptions rest on a common basis, the consideration of function as dependent on a *continuous infinity* of unknowns comprised in an interval. Hilbert regards the function to be determined as a function of an *enumerable infinity* of unknowns which are the coefficients of its development in a generalized Fourier series and the integral equation will be replaced by an enumerable infinity of linear equation between an enumerable infinity of unknowns. The solution of the integral equation is indeed only a particular application of Hilbert's ideas. "Analysis with an infinity of variables," to use his expressions, constitutes a general method applicable to many problems.

Finally we will make a few remarks on the theory of functional *ensembles*, or rather, abstract *ensembles*, of which functional *ensembles* (the *ensemble* of continuous functions, etc.) form a particular instance. This study, with which Fréchet and some other writers have dealt, would constitute a kind of introduction to the functional calculus. In a logical *exposé* of ideas it is this theory—generalized—of *ensembles* which would compose the first chapter. As we said at the beginning, however, we have not adopted the point of view of logic but that of the historical development of notions The reader now understands the philosophical range of works which can be traced directly back to the elementary principles of mathematical thought: to operation, function, continuous infinity, enumerable infinity.

I. THE PROPERTIES OF OPERATIONS.

If we wished to determine the origin of the theories we are now about to set forth, we should naturally have to go back to Leibniz. In the field of what is at present called the functional calculus, as in the theory of the differential calculus, this prophetic genius seems to have divined what was actually discovered at a later date. Pincherle, in the learned study of the *Encyclopédie des sciences mathématiques*[6] which he devotes to the functional calculus, considers that Leibniz's formula concerning the m^{th} derivitive of a product of functions constitutes one of the first interesting propositions to be connected with this branch of mathematics which has been called "calculus by symbols of operations:" There is a *formal* analogy between the development of the powers of the binomial and

[6] Pincherle, *Encyclopédie des sciences mathematiques*, Vol. II, 5, 1.

laws valid for a function (an object) are formally valid for an operation.[14] The distributive and commutative properties are applied by Servois to functions; his error—if we may use so strong an expression when dealing with a conception inevitable to the state of science at the time it was formulated—consisted in omitting to present the fact that the operative rules just mentioned apply as well to quantities strictly so called or to functions, as to the symbols of the operations. Thus, the character of the development of thought whose history we are endeavoring to sketch is that we have treated *operation* as an *object,* to use Pincherle's expression. The ideas found in germ both in Leibniz and in Servois have been developed by a series of mathematicians including Boole and Grassmann.

Note that Boole sets as an object for mathematics the study of operations considered in themselves independently of the various objects to which they may be applied.[15]

The formal point of view is explicitly indicated. We have sought to define the elementary notions of the calculus in view of their applications to the operations themselves. We say, for instance, that two objects are *equal* when they can be replaced by each other in a given combination, without the result being changed thereby. Now, this definition applies to symbols of operations as well as to numbers. We apply to the operations the notion of univocity (or uniformity): the operation is univocal (or uniform) if it gives one single result. Then, as stated above, we study the *operations* from the point of view of distributivity, commutativity, associativity.

The *sum* and the *product* of two operations are also defined. The sum of two operations A and B is an operation which, applied to any object, gives as a result the sum of the results of the application of the operations A and B to the object in question. We also know that the *product* of two operations A and B consists in applying to the result of the operation B the operation A. To sum up, the symbols of operations may be treated as quantities and we may subject these symbols to the other operations.

So far we have obtained a first degree of generalization, in the sense that we have presented certain general characters, such as the commutativity and the distributivity of the elementary operations of arithmetic or of the differential calculus. We ought to have gone further, however, and endeavored to expand the notion of

[14] Lagrange has already treated the symbol of differentiation as a fictitious dimension.

[15] Boole, *The Mathematical Analysis of Logic,* Cambridge, 1847, p. 3.

To understand adequately the development of ideas, we consider it interesting to recall Servois's text.[10]

"Let

$$\phi(x+y+\ldots\ldots)=\phi(x)+\phi(y)+\ldots\ldots$$

"The functions which, like ϕ, are such that the function of the (algebraical) sum of any number of quantities is equal to the sum of the like functions of each of these quantities, will be called *distributive*....

"Let

$$f\,h\,z=h\,f\,z.$$

"The functions which like f and h are such that they give identical results, whatever be the order in which they are applied to the subject, will be called *commutative* with one another." After developments of calculis into which we do not wish to enter, Servios applies the foregoing principles to the functions he calls differential, which he represents by $\mathrm{E}(z)$, $\Delta\,(z)$, and $d(z)$, the *varied state*, the *finite difference*, the *differential*. Note that the *varied state* of the function $z=\phi(x,\ y\ldots.)$ is a function $\mathrm{E}(z)=\phi(x+\alpha,\ y+\beta,\ldots\ldots)$, the α and the β.....being the increases of x, y, etc., and that the *difference* of z is defined by the expression $\mathrm{E}(z)-z=\Delta(z)$. It is useless to recall the definition of the differential. "Now all the differential functions and their different orders, positive or negative, are *commutative* functions, both with one another and with the constant factors....In the preceding, we have sketched the *ensemble* of the laws which unite and bring into communication all the differential functions, i. e., the most general theory of the differential calculus."[12] Like his predecessors, says Pincherle in his *Encyclopédie*[13] article, Servois frequently confuses the expressions function and operation. This "confusion," however, was in a way implied by the nature of the subject. If we had always literally admitted the radical distinction made by Pincherle, at the beginning of his article, between the *objects* on which we operate and the *operations* executed on these objects, the ideas germinal in Leibniz's work and which we see developing in Servois's works would have been arrested in their growth. The remarkable part in the theory whose history we are briefly sketching is that the

[10] Servois, *Annales de Gergonne*, vol. V, p. 98 (1814).

[11] The *subject* of the function $f(z)$, in Servois's terminology, is z.

[12] Servois, *loc. cit.*, p. 120.

[13] Pincherle, *Encyclopédie*, etc. Vol. II, 5 fasc. I.

When a transmutation is continuous and regular, the second condition is reducible to the first, c being whatsoever. Hadamard gives the name of linear to Bourlet's additive transmutations. Additive transmutations are particularly important, because the change of variable $\phi(x) = f[\phi(x)]$, (f being a given function), derivation, etc., are included in the category of additive transmutations.

Every product of additive transmutations is an additive transmutation. The sum of several additive transmutations is likewise additive. Following Bourlet, we will now give the general form of an additive transmutation by supposing it universal, continuous, and regular.

Somewhat anticipating upon the following paragraphs, we will mention that Lalesco has shown that the solution of a Volterra integral equation of the first denomination, where the nucleus $N(x, s)$ is a whole analytical function in x of smaller order than I, is equivalent to the integration of a linear differential equation of infinite order with given initial conditions. This sort of equivalence between tho different analytical instruments is particularly interesting.

We must now reconsider the definition of transmutation, from which we started, to insist with Hadamard on the fact that the transmute T (u), from Bourlet's point of view, depends on the *form* of the function $u(x)$, but that it is in addition a function of the variable x. This remark will enable us to show the dependence which exists between the ideas relative to the formal development of the operative properties and another stream of ideas, that consisting in the generalization of the elementary notions of the infinitesimal calculus, with which ideas we shall now deal.

II. FUNCTIONS THAT DEPEND ON A CONTINUOUS INFINITY OF VARIABLES.

Function is the object of analysis, just as number is the object of arithmetic. The notion of whole number is simple and clear, it was known to the ancients. The notion of function is of comparatively recent date. It is a complex notion[20] the origin of which must be sought in the idea of physical law and the geometric curve. From the time of Leibniz and Bernoulli, when the word *functio* was first

[18] *Ibid.*, p. 135.

[19] Hadamard, *Leçons sur le calcul des Variations*, p. 282.

[20] P. Boutroux, *Revue de Métaphysique*, Nov., 1904.

used, the conception of function has undergone numerous transformations.

At the end of the seventeenth and in the eighteenth century, function[21] was the name generally given to a quantity y joined to a variable x by an equation including symbols that represented elementary (algebraical, trigonometrical, logarithmic) operations. Jean Bernoulli[22] in a letter addressed to Leibniz in the year 1698, seems to have been one of the first to use the term function in something approaching its modern signification. But though the word was first uttered by Bernoulli, we may affirm that, ever since Descartes, we have known something, if not of the word, at all events of the thing (curves of analytical geometry).

Under the influence of Cartesian conceptions, the curves $y=f(x)$, were considered as functions, the relation expressing true geometrical equalities. Such functions were called continuous functions (Eulerian continuity); they constituted the real functions. A function represented by several arcs of curves was considered as being formed of parts of functions. D'Alembert, Bernoulli, Euler, Lagrange, have been led to expand the meaning of the notion of function, by studying problems in physics the solution of which implied the integration of an equation with partial derivatives of the second order. Riemann, is the first part of his memorandum "Ueber die Darstellbarkeit einer Function durch eine trigonometrische Reihe[23]" has admirably summarized the history of these discoveries, which were destined to culminate in Fourier's fundamental work. Riemann tells of the astonishment of Lagrange, then an old man, when at the meeting of the *Académie des Sciences* on the 21st December, 1807, Fourier enunciated the proposition: that a completely arbitrary function (graphically given) could be represented by a trigonometrical series in a finite interval, and that in particular a trigonometrical development was capable of representing non-continuous functions formed of parts of functions.[24] Fourier's enunciation was not absolutely rigorous. Lajeune-Dirichlet specified the exact conditions which a function must verify to be representable by a trigonometrical series. These conditions are well known by the name of Dirichlet's

[21] Lebesgue, *Leçons sur l'ntégration*, etc., p. 2.

[22] Leibniz, *Gerhardt Math. Schriften* 3, 157.

[23] Riemann, *Werke*, p. 232.

[24] See for instance Picard, *Cours d'analyse*, vol. I, p. 244; see also Jordan, *Cours d'analyse:* Jordan, as we know, has introduced into this theory the notion of function with limited variations.

conditions.[25] Influenced by these various results, Dirichlet defined a function as follows: the quantity y is the uniform function of the quantity x in a determined interval, when to each value of x taken in the interval there corresponds one determinate value of y, without specifying at all as to the way in which the values of y depend on one another.

The conception of the function in which culminates the evolution we have just set forth is that of a correspondence in the most general meaning of the word.[26] We do not think it unnecessary to insist on the meaning of the quite arbitrary notion of function as it may subsequently be conceived in the works of D'Alembert, Fourier, Dirichlet, etc. Suppose our function is represented by a line; if this line is a true curve, the "law" which characterizes it will enable us to fix each point of it; but suppose the curve is described at hazard, that in a word the curve is given only graphically. In order that the curve thus described may be regarded as determinate, we shall here have to know all its points, since, there is no connection between the points. What method of representation shall we use for such functions? If we suppose that the function verifies Dirichlet's conditions, we know that it is possible, in a determinate interval, to represent it by a Fourier series. Consequently it is first of all necessary that the function should verify certain conditions; afterward we must note that the integrals which give the values of Fourier's coefficients can be estimated but approximately when dealing with a function given graphically.

With Dirichlet we had reached the term of generalization as regards "correspondence," but it was permitted to expand the conception we were able to form of the elements to be taken as variables. It is this generalization we shall now study.

And first of all, how have we been brought to this extension of the variable? As we have said, function is the object of analysis as number is the object of arithmetic. On function we shall be able to do operations as we do them on number. In particular we may consider function as the unknown in any relation whatsoever which we will call a *functional* relation, by reason of the nature of the unknown. In this general sense, a differential equation, an equation with partial derivatives, are functional relations, since we have to determine a function in these various cases.

In these different relations function is the unknown. Conse-

[25] Dirichlet, *Werke*, Vol. I, p. 135, and *Encyclop.*, II, I, I, p. 13.

[26] P. Boutroux, *Rev. de Métaphysique*, Nov., 1914.

quently there had necessarily to take place a *rapprochement* between the *numerical variable* and the *functional variable.*

Instead of considering a function as depending on a quantity which varies, on a variable in the ordinary use of the word, Volterra considers a function which depends on the *form of a line.* This extension certainly constitutes one of the most important events in the development of the theory of functions in our time. Is it profitable to guard the reader against the confusion that might result from Volterra's conception, with the classical notion of the function of a function? In elementary mathematics, when we say that the function f is a function of the function $\phi(x)$, which we represent by $f[\phi(x)]$ the form of f and the form of ϕ are both given: the true variable will always be the variable x on which f depends through the intermediary of ϕ.

Volterra was the first (*Rendiconti della R. Accad. dei Lincei,* Vol. III) to consider the functions of lines. We will refer to the memorandum which appeared in Vol. XII of the *Acta mathematica* (1889), a memorandum entitled: On a generalization of the theory of the functions of an imaginary variable. In a note (page 234 of the memorandum) Volterra has explained how, starting with the conception of function of lines. "In several questions of physics and analysis, we find quantities which depend *on all the values* of an ordinary function or of several totally arbitrary ordinary functions. For instance the temperature at the tip of a blade whose edge is heated depends on all the values of the temperature at the edge of the blade. Functions of lines offer another instance of like dependence."

Functions of lines enable us to depict geometrically the function which depends on all the values of a function. As an instance of the function of lines, we may consider the area comprised between the axis of the x's two ordinates raised to the points a and b and the variable portion of line connecting the two ordinates. We see that the form of the line $y=f(x)$ depends on the ordinates $y_1, y_2, \ldots y_n \ldots$ which we can raise at each point of the interval (a, b), and which form a continuous infinity. Manifestly in this sense, to consider a function which depends on the *variable* function $y=f(x)$, is to consider a function which depends on a *continuous* infinity of unknowns. The area will therefore depend on a continuous infinity of unknowns, the $y_1, y_2 \ldots$ Hadamard's *functionals* can evidently be traced to Volterra's conception. According to Hadamard

a functional is a function F which depends on the form of another function *f*. The calculus of Variations becomes, as Hadamard has remarked (*loc. cit.*, Preface) a chapter of the functional calculus.

Volterra has extended the elementary principles of the infinitesimal calculus to the new notion of function; thus we will study in succession its *continuity, derivability, variation, development in series of powers, analyticity.*

Generalization of the theory of the functions of a complex variable. We know that in the elementary theory of the functions of a complex variable, we call *monogenic* or *analytic* a function $U=P(x, y)+ia(x, y)$, of the variable $z=x+iy$ the derivative of which is *unique* for each value of z.

The conditions of monogeneity relative to the partial derivatives of P and Q are too well known to need mention here.

Volterra has attemped to extend to three-dimensional space the theory of the functions of complex variables. To realize this extension he has had to resort to the notion of functions of lines (*Acta math.*, Vol. XII, p. 235): "We obtain generalization," he says, "by making correspond to each closed line of space the values of two imaginary variables bound to each other by a differential condition absolutely similar to the condition of *monogeneity* of the ordinary theory."

This relation similar to the monogeneity which will exist between functions of lines (imaginary variables of the quotation) will be called a relationship of *isogeneity.*

Let F and Φ be the values of two functions corresponding to a line L. Let us deform an arc A B from L and designate by Δ F and Δ Φ the variations of F and of Φ. If, by indefinitely diminishing the deformation and the distance between B and the fixed point A, the relation $\Delta F/\Phi\Delta$ tends toward a limit which depends solely on the point A, we say that the two variables have a relationship of *isogeneity or* that they are *isogenous.*

Starting from this definition a theory similar to the classic theory of monogenic functions will be elaborated. Especially we shall obtain a differential relation analogous to the equation with partial derivatives of the second order already mentioned. Thus Volterra develops a general theory starting from the principles just enunciated; we shall find this theory set forth in Vol. XII of the *Acta mathematica.*

[27] Hadamard, *Leçons sur le calcul des Variations*, p. 282, etc.

[28] Volterra, *Leçons sur les équations intégrales et les équations integro-différentielles*, p. 10, etc.

We think we have adequately characterized the fundamental notions connected with the idea of function which depends on a continuous infinity of variables in an interval.

III. FUNCTIONS WHICH DEPEND ON AN ENUMERABLE INFINITY OF VARIABLES.

Whereas in the preceding paragraph we have examined the functions which depend on a *continuous* infinity of variables in an interval, we shall now consider functions which depend on a *discrete* or enumerable infinity of variables. It is in this way that Hilbert and Le Roux regard a function as a mathematical being dependent on an infinity of independent variables. For instance, Fourier's series are linear functions of their coefficients considered as independent variables. We shall see how this conception can be traced back simply to the most elementary algebraical notions. Whereas in algebra we have to determine a *finite* number of dimensions by a *finite* number of equations, in analysis we have to determine *functions* by functional equations: differential, integral equations, etc. But the second problem may be considered as a limit case of the first, if instead of considering a finite number of unknowns, determined by a finite number of equations, we consider an *infinite* number of unknowns determined by an *infinite* number of equations.

A function $\phi(x)$ being represented by a development in Fourier's series, the function may be considered as determined if we know the coefficients of Fourier's series. The unknowns $x_1, x_2 \ldots$. which constitute an enumerable infinity will be the solutions of a system of a discrete infinity of equations with a discrete infinity of unknowns. This system will be equivalent to the primitive functional relation.

Hilbert has mentioned the relations existing between his theory and the works of Hill, Poincaré, and Helge von Koch on systems of an infinity of linear equations with an infinity of unknowns and on infinite determinants. Indeed, the problem of the solution of such a system presents itself whenever we try to set up a development in series by the method of indeterminate coefficients.

Hill, in a problem of astronomy dealing with the movements of the moon, reduces the integration of a differential equation to the solution of a system of an infinite number of linear equations with an infinity of unknowns. It was natural to introduce the notion of

[29] Hilbert, *Grundzüge einer allgemeinen Theorie der linearen Integralgleichungen*, Leipzig, 1912.

[30] Le Roux, *Nouvelles Annales de math.*, 1904.

determinants, as we find it in elementary algebra, into the theory of the solution of equations with an infinity of unknowns.

In his work, therefore, Hill[31] has made use of infinite determinants. Later on, Poincare[32] rigorously set up the conditions of convergence of the special infinite determinants considered by Hill. The ideas of Hill and of Poincaré have been considerably developed by Helge von Koch.

In the following section we will set forth one of the best known applications of the preceding theory, the one dealing with integral equations. It must not however be thought that that is the only application of analysis: other mathematical disciplines may be studied from the point of view of analysis with an enumerable infinity of variables: the calculus of Variations, for instance. Indeed, in the calculus of Variations, we seek to determine a function $\phi(s)$ which is to render minimum a certain dimension dependent in a given way on $\phi(s)$. If we represent the function $\phi(s)$ by means of a complete orthogonal system of functions $\phi_1(s), \phi_2(s)\ldots$. by the expression:

$$\phi(s) = x_1 \phi_1(s) + x_2 \phi_2(s) + \ldots$$

we see that our problem consists in determining the variables in infinite number $x_1, x_2\ldots$. in such a way that a certain given function of these variables becomes minimum.

Thus the problem of the calculus of Variations is reduced to the search for a minimum, a search which belongs to the differential calculus of functions with an infinity of variables.[33] Without passing by the medium of integral equations, we may also directly broach the theory of differential equations by means of analysis with an infinity of variables.

Consequently, analysis with an infinity of variables appears less as a particular process which can be used only for a special class of problems than as a very general method which has proved its fecundity by its many applications.

IV. INTEGRAL AND INTEGRO-DIFFERENTIAL EQUATIONS. EQUATIONS WITH FUNCTIONAL DERIVATIVES.

In integral and integro-differential equations, as we shall see, the unknown is a function of a variable; on the other hand, in equations with functional derivatives, the unknown is a function

[31] Hill, *Acta math.*, 1888.

[32] Poincaré, *Bulletin de la Société math. de France.*

[33] Hilbert, *Rendiconti del Circolo mat. di Palermo*, vol. XXVII, 1909.

of lines. Logically, therefore, the study of these latter should be placed at the end of section II, dealing with the functions of a continuous infinity of variables (functions of lines). We have thought it preferable, however, because of the elementary character and the restricted scope of our study, to unite in one and the same paragraph everything that deals with the application of general principles to equations.

Integral equations. An integral equation is an equation in which the unknown function is represented under an integral sign. Sometimes we call such an equation a *functional equation.* Evidently we may apply the name of functional—in its broad sense—to any equation whose unknown is a function. In this way, differential equations and equations with partial derivatives would also be functional equations; speaking generally, however, following a custom which may not be altogether justified, we reserve the name of functional equations for special types of equations which are not included in one of the great classes (differential, with partial derivatives, integral, etc.), for instance, for the relations:

$$f(x+y)=f(x)+f(y)$$
$$f(x+y)=f(x).f(y)$$

considered by Legendre and Cauchy where we have to determine the unknown f; no sign of differential or integral calculus appears in these latter equations.[34]

As we know, Abel[35] was the first (in 1823 and 1826) to study, with reference to a problem in mechanics, an equation in which the unknown function is given under an integral sign. Liouville, who about the year 1832 had considered Abel's equation, showed a little later on (in 1837: *Journal de Liouville*, II, p. 24) how it was possible to obtain a particular solution of a certain linear differential equation by solving an integral equation of a somewhat different type (equation of the second kind) from that discovered by Abel (equation of the first kind). To solve the integral equation, Liouville has used a method which can be traced to the *calculus of iteration*, a calculus the principle of which may be summarily formulated as follows.[36] Let the equation be:

$$x=\mathrm{F}(x)$$

where x is an unknown number and $\mathrm{F}(x)$ a known function of x.

[34] Abel, Schröder, etc., have also considered special functional equations.
[35] Abel, *Œuvres*, I, 11.
[36] Heywood and Fréchet, *Equation de Fredholm*, etc., p. 36.

Under certain conditions of continuity we obtain the solution of this equation by indefinitely reiterating the operation F. That is to say, the succession:

$$x_1=F(x_0),\ x_2=F(x_1),\ldots.x_n=F(x_{n-1})\ldots.$$

in which x_0 is arbitrary, tends toward the root of the equation:

$$x=F(x).$$

It is possible to use a similar process for solving the integral equation found by Liouville.

The different streams of ideas, however, which we have endeavored to characterize in the two preceding sections, by going back to the principles of analysis, revealed the true meaning of integral equations and at the same time supplied the most rational methods of solution. We shall consider in succession the points of view of Volterra, Fredholm, and Hilbert. We know, in the case of the first two, that the unknown function is regarded as dependent on a continuous infinity of variables (functions dependent on all the values of a function in an interval), whereas in the case of Hilbert, the function depends on an enumerable infinity of variables. We shall try to show how, to these two fundamental conceptions, can be traced two methods of solving integral equations. Here we need not enter into the details of calculus—which after all would now be quite useless after the publication of excellent treatises dealing with the subject[87]—but simply have shown how the fundamental ideas are linked together. We shall have recourse to technical considerations only so far as is necessary for fixing the ideas.

Integro-differential equations.—The theory of the integro-differential equations now constitutes a most important chapter in analysis; there can be no doubt but that its importance will continue to increase. Not to give our work a scope of which it does not admit, we will merely offer a few general remarks on this point.

We know that in integral equations the *unknown function* figures under an integral sign. The derivatives or partial derivatives of this unknown function may also appear under the integral sign; then we find ourselves confronted with a new type of equations: the integro-differential equations studied both by Hadamard and by Volterra. All the same, the equations of Hadamard and those of Volterra are not interchangeable.

[87] Bocher, *Introduction to the Study of Integral Equations;* Lalesco, *Introduction á l'étude des équations intégrales;* and the works of Volterra, Heywood, Fréchet, etc., already mentioned.

Whereas the equations of Hadamard may be compared with ordinary differential equations, and are integrated by methods similar to those that apply to these equations, those of Volterra resemble equations with partial derivatives. As regards the applications of the integro-differential equations of Volterra, note that if the future state of a physical phenomenon depends only on its present state, or on the state infinitely near, i. e., if it is not *hereditary*, according to Picard's expression, the problems this phenomenon may raise must be solved by means of ordinary differential equations or of equations with partial derivatives. But if the future state of the phenomenon depends not only on the present state but on all the preceding states; when, in a word, it depends on the past of the phenomenon, the problems we shall have to consider will then be of the hereditary type and the equations which will suit them will then be, as a rule, integro-differential equations; the term integral representing, if we may so express it, the action of the past.

The theory of equations with functional derivatives can be traced directly to the ideas developed in our second section on Volterra's functions of lines or of surfaces and Hadamard's functionals (functions which depend on the *form* of another function). Just as a relation between a function of a variable, its ordinary derivative and the variable is called a differential equation, so a relation between a function of a line (or a functional), its derivative (in Volterra's meaning), the line and the point on which the function depends, will constitute an equation with functional derivatives.

It may happen that the function depends on two points which figure as parameters in the equation. Green's function is actually a function of two points and of a closed surface (case of space).

If the two points A and M are fixed and the surface S varies, then Green's function is a functional of S; Hadamard has calculated the infinitesimal variation of Green's function when S alone varies. Hadamard has largely developed these theories but we cannot now enter into any details. We will simply state that the equation with functional derivatives[38] which Paul Lévy has called Hadamard's equation plays an important part in these questions. Lévy remarked that this equation was *completely integrable*;[39] this latter expression having a signification analogous to that which it has in the theory of equations with total differentials.

[38] Paul Lévy, thesis, p. 21.

[39] *Ibid.*, p. 67.

V. SUGGESTIONS ON THE GENERALIZED THEORY OF ENSEMBLES.

We have seen that one of the essential characters of the functional calculus is that a function is no longer considered as solely depending on one or a finite number of variables in the ordinary sense of the word: it may depend on the form of a line, of a surface, on the form of a function, etc. In the ordinary theory of functions, we had only to consider, with reference to the variable, *ensembles* of points; we shall now have to consider *ensembles* of curves, *ensembles* of functions, etc. Consequently, the classic theory of *Ensembles,* especially the analysis of the continuum which it comprises, will have to be extended so as to apply to generalized functions, i. e., to functions of lines, to functionals, etc.

In the theory of the functions of a variable, geometric intuition supplied us with suggestions as to the nature of the linear, superficial or spatial continua which the variable was compelled to describe. As Hadamard[40] however, remarks: "The functional continuum—i. e., the multiplicity obtained by causing a function to vary continually in every possible way—presents to our mind no simple image whatsoever.

"Geometric intuition tells us nothing about it *a priori.* We are compelled to remedy this ignorance and this we can do only analytically, by creating for the use of the functional continuum a chapter on the theory of *ensembles.*"

This is the task to which Fréchet and a few other geometricians have given themselves.

Logically, this generalized theory of *ensembles* should constitute the introduction to the functional calculus, as the theory of the *ensembles* of points serves as a preface to the classic theory of the functions of a variable. In one case as in the other, however, the most abstruse logical investigations have chronologically appeared last. And as in the preceding pages we have in no way been dealing with a logical systematization of new theories—for a very good reason—we have been forced to keep to the historical sense. In Fréchet's work[41] there are two kinds of investigations closely connected; the one deals with the theory of *ensembles* considered in themselves, especially of abstract *ensembles,* i. e., *ensembles* the

[40] Hadamard, L'Enseignement mathématique, January 1, 1912.

[41] Fréchet, "Sur quelques points de calcul fonctionnel," *Rendiconti del Circolo mat. de Palermo,* Vol. XII, 1906.

nature of whose elements is not specified, the other has for its object to determine the properties of the functional operations (the most general correspondences between elements of abstract *ensembles*,[42] which are defined in these *ensembles*. Here we find notions similar to those studied in section I, on the properties of operations.

We have first to fix the principles of the theory of abstract *ensembles*. Afterward we will apply general theorems to *ensembles* of a particular nature.

The most important results of the theory of *ensembles* are those we deduce from the notion of the limit of a succession of elements. Now, "if we examine[43] the various definitions of the *limit* of a succession of numbers, or of a succession of points, or of a succession of functions, etc., we note that these definitions satisfy two conditions which may be enunciated independently of the nature of the elements considered." For the future we shall consider only *ensembles* taken from a class (L) of elements whatsoever, but satisfying the following conditions. We may recognize if two elements of a class (L) are distinct or not. We may give a definition of a succession of elements of class (L). The two conditions satisfied by the definitions of the limits are as follows:

i. If each of the elements of the infinite succession $A_1, A_2 \ldots A_n \ldots$ is identical to one and the same element A, the succession has certainly a limit which is A.

ii. If an infinite succession $A_1, A_2 \ldots A_n \ldots$ has a limit A, any succession of elements of the first succession taken in the same order: $A_{n_1}, A_{n_2}, \ldots A_{n_p} \ldots$ (the integers $n_1, n_2, \ldots n_p \ldots$ continuing to increase) has a limit which is also A.

We have now to apply to abstract *ensembles* the definitions of the theory of punctual *ensembles*.

The notions of *limit element, derived ensemble, closed ensemble, perfect ensemble,* easily extend to abstract *ensembles*. Fréchet introduces a new notion, that of *compact ensemble*. An *ensemble* is compact when it includes only a finite number of elements or when any infinity of its elements gives place at least to a limit element. When an ensemble is both compact and closed, we will call it an *extremal ensemble*. The role of the extremal ensemble in the theory of abstract *ensembles* is similar to that of the interval in the theory of linear ensembles.

[42] Montel; *Ann. Ecle normale*, 1907.

[43] Fréchet, *loc cit.*, p. 5.

We shall say that a *functional operation* V uniform in an *ensemble* E of elements of a class (L) is continuous in E, if, whatever be the element A of E limit of a succession of elements A_1, $A_2 \ldots A_n \ldots$ of E, we always have:

$$V(A) = \lim_{n=\infty} V(A_n)$$

A sequence of uniform operations in E converges *uniformly* in E toward an operation U, if, whatever be the number $\epsilon > O$, we can find an integer p such that $n < p$ has for its result $|U_n(A) - U(A)| < \epsilon$ in every element A of E.

We shall say that uniform operations[44] in one and the same *ensemble* E formed of elements of a class (L) constitute a family F of operations *equally continuous* in A in E, if, given a number $\epsilon > o$ and a succession of elements of E: A_1, $A_2 \ldots$ having for limit an element A of E, we can find an integer p so that the inequality $n > p$ has for its result:

$$|U(A) - U(A_n)| < \epsilon$$

whatever be the operation U of the family F.

The generality of the classes (L), however, does not permit of a great number of the properties of linear *ensembles* being extended to them. To obtain new properties the conception of the classes (L) must be restricted. Fréchet proceeds as follows: he considers a class (V) of elements whatsoever, though such that we can distinguish whether or not two of them are identical, and such, also, that to any two of them whatsoever A, B, we can make to correspond a number $(A,B) = (B,A) \geq o$ which has the two following properties: (i) the necessary and adequate condition that (A,B) should be nil is that A and B should be identical; (ii) whatever be the elements A, B, C, it suffices that (A,B) and (B,C) be small for the same thing to be affirmed of (A,C). The number (A,B) will be called the *vicinity* of A and of B.

The *ensemble* derived from an *ensemble* of elements of a class (V) is a closed *ensemble* [this was not necessarily the case in the classes (L)].

We shall again restrict the conception of the classes (V) but without yet specifying the nature of the elements considered.

We shall say that a succession of elements A_1, $A_2 \ldots$ of a class (V) satisfies Cauchy's conditions, when to any number $\epsilon > o$, we can

[44] Fréchet, *loc. cit.*, p. 11.

make correspond an integer n such that the inequality $(A_n, A_{n+p}) < \epsilon$ be verified what p may be.

A class (V) admits of a generalization of Cauchy's theorem, if any succession of elements of this class, which satisfies Cauchy's conditions, has a limit element.

When a class may be considered, in a way at least, as the derived *ensemble* of an enumerable *ensemble* of its own elements, it is called *separable*. Perfect and separable classes and those that admit of a generalization of Cauchy's theorem are called *normal* classes (V). Fréchet again defines the continuity of an operation by means of vicinity. In conclusion we will give only his definition of the *divergence*[45] *which* intervenes when we consider concrete examples. "It will be recognized that, in each case, it is possible to make correspond to any couple of elements A,B a number $(A,B) \geq o$ which we will call the *divergence of the two elements* and which possesses the two following properties: (i) the divergence (A,B) is nil only if A and B are identical; (ii) if A, B, C are three elements whatsoever, we always have $(A,B) \leq (A,C) + (C,B)$." The divergence satisfies the conditions imposed on the definition of vicinity.

The abstract theory on which we have just given a few suggestions, will be applied to *ensembles* whose nature will be specified. Thus Fréchet applies his general results at first to the *ensembles* of continuous functions and to the operations which bear on these functions, i. e., to the functionals; afterward he applies them to *ensembles* of points of space with an enumerable infinity of dimensions and to functions with an enumerable infinity of variables, etc. Need we remark that generalizations, like that of Fréchet, are interesting in proportion as they admit of the advance of the particular theories and the clearly determined problems from which they have sprung? By developing on their own account purely abstract theories, we should risk being led astray in the realms of formal logic and scholasticism.

In the preceding study, we hope we have set forth the importance of a line of thought which has proved itself alike fruitful in the realm of analysis, of which it is nothing but a generalization, and in that of applications. We shall not risk comparing this phase of the development of mathematics with another phase of its evolution, but we do not think we shall lay ourselves open to contradiction if we say that it appears as one of the most fruitful. It

[45] As regards Fréchet's definition of divergence Baire has made a reservation which is deserving of mention (See *Encyclopédie*, I, 1, 4, p. 530).

was no part of our plan to set forth the results which mathematical physics has obtained by the use of the new analytical instrument. Now, mathematical physics which thoroughly examines and co-ordinates the observations of experimental physics seems more and more as though it should take the place of what was formerly called, somewhat vaguely, the *philosophy of nature*. Unlike the theories, however, included under this name, mathematical physics is subject to geometrical discipline: it must prove what it advances. Moreover, it frequently contributes directions to the experimenter in his investigations. In spite of this fact, we cannot deny that mathematical physics retains an essentially theoretical and philosophical character: its main purpose is not to further the progress of industry but rather to make known the infrastructure of the universe. The functional calculus, by renewing the methods of mathematical physics, has enabled us to make further progress in the study of natural phenomena.

MAXIMILIEN WINTER.

PARIS, FRANCE.

BOOK REVIEWS AND NOTES.

A First Course in Nomography. By *S. Brodetsky*. London: G. Bell & Sons, Ltd., 1921. Pp. x, 135. Price, 10s. net.

Nomography owes its name, and to a large extent its development to d'Ocagne; and as a science it is best studied in d'Ocagne's own work, *Traité de Nomographie* (G. Villars, Paris, 1899). There are, however, numerous classes of students, to whom the methods of nomography are of great service; whereas, at any rate in their eyes, the science that underlies the subject is of secondary importance only. The great advantages possessed by nomograms was brought into prominence during the war; and in recent engineering treatises it is quite a customary matter to find one or more nomograms, more especially in connection with empirical formulae. For these reasons, I consider that Dr. Brodetsky, in keeping before his eyes the needs of such students, and the fact that any mathematical knowledge they have will be of the "practical" order, has made a very wise choice in his method of presentment. He states in his preface that this choice was based on experience gained in making nomograms for various technological departments in the University, and in other ways. Hence, at the very least, the elementary and clear treatment given in the book under review has the merit that it is based on real practical experience.

It certainly would have been helpful to many readers if the author had inserted, on p. 11, a geometrical figure and proof of the method for finding the ordinate of a point dividing the line joining two given points in a given ratio; but otherwise the work runs very clearly through the addition formulae, such as $la+mb$, with equally divided scales, to product formulae, such as $a^l b^m$, with logarithmic scales, and the generalisations of each. Also, it might have been wise to have compared the use of nomograms with the use of the slide-rule, and the analogy between reference lines and the cursor in simple cases; but, of course, this is not essential.

In Chapter V, the theory of parallel co-ordinates is given; and in Chapter VI, this is applied to such transcendant formulae as $nt = \phi - e\sin\phi$, and various trigonometrical formulae and equations. Chapter VII gives examples of the use of intersecting scales; and Chapter VIII gives details of empirically constructed scales, such as for the solution of $bx = a^x$. This closes a highly interesting and eminently practicable introduction to nomography, which should find a large public.

J. M. CHILDS.

ELEMENTARY VECTOR ANALYSIS. By *C. E. Weatherburn*. London: G. Bell & Sons, Ltd., 1921. Pp. xxviii, 184. Price, 12s. net.

We welcome this elementary treatise on Vector Analysis as a book that has been wanted in English for some time. The author confines himself entirely to the elementary parts of the subject, but treats them very fully. Many applications of vectors to geometry, kinematics, to dynamics, both of rigid bodies and of a particle, and to statics are given. To get the student of dynamics to think in terms of vectors is wholly to the good; for, apart from the greater elegance of vector methods, it gives him a much clearer realization of the physical realities of the problems than is attained by the ordinary analytical methods.

The more advanced parts of the subject dealing with "curls," "gradients" and "divergence," which are of such fundamental importance in the study of Electromagnetism, are omitted. It is to be hoped that the author will supplement the present work by another volume dealing with these more advanced portions, which will be as valuable to students of Electromagnetism as the present volume is to students of dynamics for whom these higher portions are unnecessary.

A word is perhaps necessary on the notation adopted for the scalar and vector product of two vectors. The author discards the familiar brackets ( ) and [ ] for these products and uses a dot and a cross respectively between the terms. One must admit that in actual work this notation is more convenient, as the brackets are then available for ordinary algebraical needs; but some uniformity of practice among writers is urgently to be desired. The subject is quite sufficiently developed now to insist upon the adoption of some standard notation for it.

ALBERT EAGLE.

AN ELEMENTARY TREATISE ON DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS. By *H. T. H. Piaggio*. London: G. Bell and Sons. Pp., xvi, 216, xxv. Price, 12s. net.

There are many physicists and engineers today, who have often longed for a short and readable treatise on Differential Equations; but who have found themselves repelled by the ponderous and academic volumes that have been produced hitherto upon the subject. Dfferential Equations, as it were, have up till now existed but for the mathematician, and have been jealously guarded by the exhaustive nature of the treatises published. Prof. Piaggio has supplied this long-felt want. In his work we have, condensed into approximately two hundred pages, an account of Differential Equations, suitable for those with no previous knowledge of the subject, and yet amply sufficient to cover the course required for an Honours degree. One feature of the book which especially appeals to us is the superabundance of excellent examples, to which are added explanations of their physical significance. The engineer will be as delighted to find how soon he can understand the phenomenon of resonance (p. 36), as will the physicist to find himself (on p. 48) solving the differential equations used by Sir J. J. Thompson in a recent important contribution to the *Philosophical Magazine*. The miscellaneous examples at the end of the book with their interesting notes—as, for example, on the Zeeman effect, on Hamilton's dynamical equations, or on Einstein's equations of Planetary Motion —will be especially welcome. Graphical methods and Numerical Approximations form an important feature of the book and are quite up-to-date, including methods hitherto unpublished. In conclusion, we congratulate the author on producing a book which is concise without being obscure, and scholarly without being academic.

J. E. J.

THE ORGANIZATION OF THOUGHT, EDUCATIONAL AND SCIENTIFIC. By *A. N.* Whitehead. Pp. viii, 228. London: Williams and Norgate. Price 6s net.

This book consists of reprints of seven addresses and other papers together with one article which has not been published before. The first five chapters deal with education, and are: "The Aims of Education—a Plea for Reform," Presidential Address to the Mathematical Association in 1916 (pp. 1-28); "Technical Education and Its Relation to Science and Literature," Presidential Address to the same Association in 1917 (pp. 29-57); "A Polytechnic in War-

time," an Address given in 1917 (pp. 58-68); "The Mathematical Curriculum," Presidential Address to the Mathematical Association in 1912 (pp. 69-91); and "The Principles of Mathematics in Relation to Elementary Teaching," a paper read to the International Congress of Mathematicians at Cambridge in 1912 (pp. 92-104). The remaining three chapters contain discussions on certain points arising in the philosophy of science, and are: "The Organization of Thought," Presidential Address to Section A of the British Association in 1916 (pp. 105-133); "The Anatomy of Some Scientific Ideas" (pp. 134-190); and "Space, Time, and Relativity," a paper read to Section A of the British Association in 1915 and afterwards to the Aristotelian Society (pp. 191-228). Of these chapters the second, sixth, and eighth have been already noticed at some length in the MONIST; thus we will here confine our attention to the remaining five essays. It must be remembered a common line of reflection runs through the whole book, and the two sections influence each other (p. v).

The two commandments to be obeyed in any educational scheme are: Do not teach too many subjects, and what you teach, teach thoroughly (p. 3). In training a child to activity of thought, we must beware of ideas that are merely received into the mind without being utilized or tested or thrown into fresh combinations (p. 4). Such "inert ideas' have overladen schools of learning at certain periods, and the above commandments indicate the way to guard against the "mental dry rot" that these inert ideas produce (p. 5). "The result of teaching small parts of a large number of subjects is the passive reception of disconnected ideas, not illumined with any spark of vitality. Let the main ideas which are introduced into a child's education be few and important, and let them be thrown into every combination possible. The child should make them his own, and should understand their application here and now in the circumstances of his actual life. From the very beginning of his education, the child should experience the joy of discovery. The discovery which he has to make is that general ideas give an understanding of that stream of events which pours through his life, which is his life. By understanding I mean more than a mere logical analysis, though that is included. I mean 'understanding' in the sense in which it is used in the French proverb, 'To understand all is to forgive all'" (pp. 5-6). The old notion that the mind is an instrument to be first sharpened and then used is "one of the most fatal, erroneous, and dangerous conceptions ever introduced into the theory of education. The mind is never passive, it is a perpetual activity, delicate, receptive, responsive to stimulus. You cannot postpone its life until you have sharpened it. Whatever interest attaches to your subject-matter must be evoked here and now; . . ." (p. 12). "There is only one subject-matter for education, and that is life in all its manifestations. Instead of this single unity, we offer children—algebra, from which nothing follows; geometry, from which nothing follows; science, from which

nothing follows; history, from which nothing follows; a couple of languages, never mastered; and lastly, most dreary of all, literature, represented by plays of Shakespeare, with philological notes and short analyses of plot and character to be in substance committed to memory" (pp. 13-14). We ought, for example, to use as examples for graphs in algebra the curves occurring in history and other studies of society (p. 16). "English education in its present phase suffers from a lack of definite aim and from an external machinery which kills its vitality. . . . England halts between two opinions. It has not decided whether to produce amateurs or experts" (pp. 25-26). "The essence of education is that it be religious. . . . A religious education is an education which inculcates duty and reverence. Duty arises from our potential control over the course of events. Where attainable knowledge could have changed the issue, ignorance has the guilt of vice. And the foundation of reverence is this perception, that the present holds within itself the complete sum of existence, backwards and forwards, that whole amplitude of time which is eternity" (p. 28).

In this address is manifested Dr. Whitehead's intense sympathy with that side of teaching in which the technical uses of an abstract science are emphasized; this by no means separates him from the majority of other mathematical logicians. To many, indeed, it seems rather striking that some of the greatest advocates of such "practical" methods of teaching mathematics are to be found among logicians. But what does, it seems, separate Dr. Whitehead from perhaps the majority of the modern school of mathematical logicians is the fact that he emphasizes the great value of the history of mathematics in teaching. But the remark in the fourth chapter should be taken to heart: "Another way in which the student's ideas can be generalized is by the use of the history of mathematics, conceived not as a mere assemblage of the dates and names of men, but as an exposition of the general current of thought which occasioned the subjects to be objects of interest at the time of their first elaboration" (p. 81). "Perhaps," he says (p. 82), "it is the very subject which may best obtain the results for which I am pleading."

The fourth chapter is concerned with two sides of mathematical study (general ideas of (1) quantity and number and (2) laws of nature), and also logical method (pp. 78-79, 79-81, 82). Then there is an indication (pp. 83-89) of some stages in an ideal course of geometry "and ideals can never be realized" (p. 89).

The fifth chapter of the book is concerned with the investigation of the place which should be occupied by modern investigations respecting mathematical principles in the education of the majority of boys in secondary schools, and Dr. Whitehead's thesis is (p. 99) that a power of concentrated logical

thought "cannot be assumed, and has got to be acquired, and that a mathematical training is nothing else than the process of acquiring it." In this essay, among the memorable sentences which occur so frequently in the book the following strikes the reviewer as particularly important as bringing out that logic is really being taught even in a mathematical course. "When logic begins, definite particular individual things have been banished. I cannot relate logically this thing to that thing, for example this pen to that pen, except by the indirect way of relating some general idea which applies to this pen to some general idea which applies to that pen. And the individualities of the two pens are quite irrelevant to the logical process. . . . Thus the practice of logic is a certain way of employing the mind in the consideration of such ideas; and an elementary mathematical training is in fact nothing else but the logical use of the general ideas respecting geometry and algebra which we have enumerated above" (p. 97).

The seventh essay is not concerned with what scientists in the past meant to achieve, or thought that they could achieve. What is discussed is the natural history of ideas and not volitions of scientists. "There is a twofold scientific aim: (1) the production of theory which agrees with experience; and (2) the explanation of commonsense concepts of nature, at least in their main outlines" (p. 140). In succession the essay deals with facts, objects, time and space, and fields of force. In the third part the relation of whole and part is dealt with in a way that forms a complement to the sixth chapter, and then Dr. Whitehead's well-known construction of a mathematical "point," straight lines and planes, and empty space are shortly dealt with. In the conclusion, ontological ideas are introduced again—they were banished at the beginning of the chapter.

This book, with its emphasis on the fact that mathematics should appear to the student as a living and growing thing, and its wide sympathy with the process of becoming acquainted with abstract things by familiarity with practical applications, is the most welcome and stimulating news that has been received by learners for many years. It is to be hoped that teachers will give due weight to Dr. Whitehead's important contributions. One thing might be added. The way that suggests itself before everything else for arousing interest in a student's mind at the very beginning of work on a mathematical subject is the study of the physical and other practical problems by which the methods were developed. We can imagine no better training for anyone who is trying to get familiar with the calculus than working through the problems devised by Leibnitz and the Bernoullis toward the end of the seventeenth century. Only by such means, it seems, can one get at once an idea of what people who teach presumably mean when they talk about the "great power of the calculus" as compared with Cartesian methods.

DOES NOT CIRCULATE

Stanford University Libraries
3 6105 007 383 131

NON-CIRCULATING

Stanford University Library
Stanford, California

In order that others may use this book, please return it as soon as possible, but not later than the date due.